MRU

INTERFACE MANUAL

DOCUMENT REF : **MRU**-IM-1.0-EN

BALOGH SA
189 Rue d'Aubervilliers - CP 97 - 75886 Paris
Cedex 18 - France
Téléphone: 33 (0)1 44 65 65 00
Fax: 33 (0)1 44 65 65 10
Web: http://www.balogh-rfid.com

BALOGH TAG
3637 Old US-23
Brighton, Michigan MI 48114, USA
Tel: USA (800) 252-RFID (7343)
(810) 360-0182
Canada (800) 258-RFID (7343)
Fax: (810) 360-0237

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1 FOREWORD

1.1 PURPOSE OF THIS MANUAL

This manual presents the BALOGH reader MRU
It describes how to use it and how to connect it to a host system.
Further information pertaining to installation and mounting can be found in the User manual (reference MRU-MU-x.y-EN).

1.2 DOCUMENT NAMING CONVENTIONS

The coding used for a manual name is:

<device name>-IM-II-L

in which:

IM signifies Interface Manuel
II refers to the issue or version number
L refers to the language of the manual

1.3 DOCUMENT STATUS SHEET

Version	Date	Description of changes
1,0	01/03/2013	Creation (translation of French version 1.0)

1.4 NOTE

The contents of this manual are subject to changes without notice.
BALOGH can not be held responsible for the consequences of any error, omission, or incorrect interpretation of the information provided.

2 DESCRIPTION OF READER

2.1 GENERAL DESCRIPTION

The MRU readers allow remote identification on the fly, reading and writing of UHF tags
The reader is a compact all-in-one device. The weatherproof housing of sober design contains all the functional elements of the reading unit: Antennas, Microwave generator, receiver, CPU and communication interface.
The reader can be mounted directly onto any panel, even a metallic one. An optional tilt and swivel mount allows installation on both poles and flat surfaces. In this way the antenna can be appropriately pointed to the zone where the tags need to be identified.

The main characteristics are as follows:

- Case dimensions: 186 x 186 x 33mm
- Overall dimensions: 186 x 186 x 58 mm
- Weight: 1,8Kg
- Cover colour: Grey RAL 7035
- IP65 protection
- Power requirements: between +12Vdc and +24Vdc, max current 1.5A.
- Operating temperature: -20℃ to +50℃

2.2 WARNING

Installation of readers must only be done in zones where the technical and environmental conditions comply with those specified by the manufacturer.

BALOGH cannot be held responsible for any damages caused by an incorrect installation.

Any changes made to the device will immediately nullify the warranty.

2.3 COMMUNICATION INTERFACES

These readers can be used in place of most conventional controllers, both contact and contact-less.

Communication with a "host" system takes place using the following standardised links:
• Open-collector:
DATA/CLOCK, WIEGAND 26bits
• Serial asynchronous:
RS232, RS422 or RS485
ETHERNET
USB
For the USB, RS and ETHERNET links, full two-way communication is possible using the MODBUS™ protocol.
For some versions, all the interfaces are not available simultaneously.

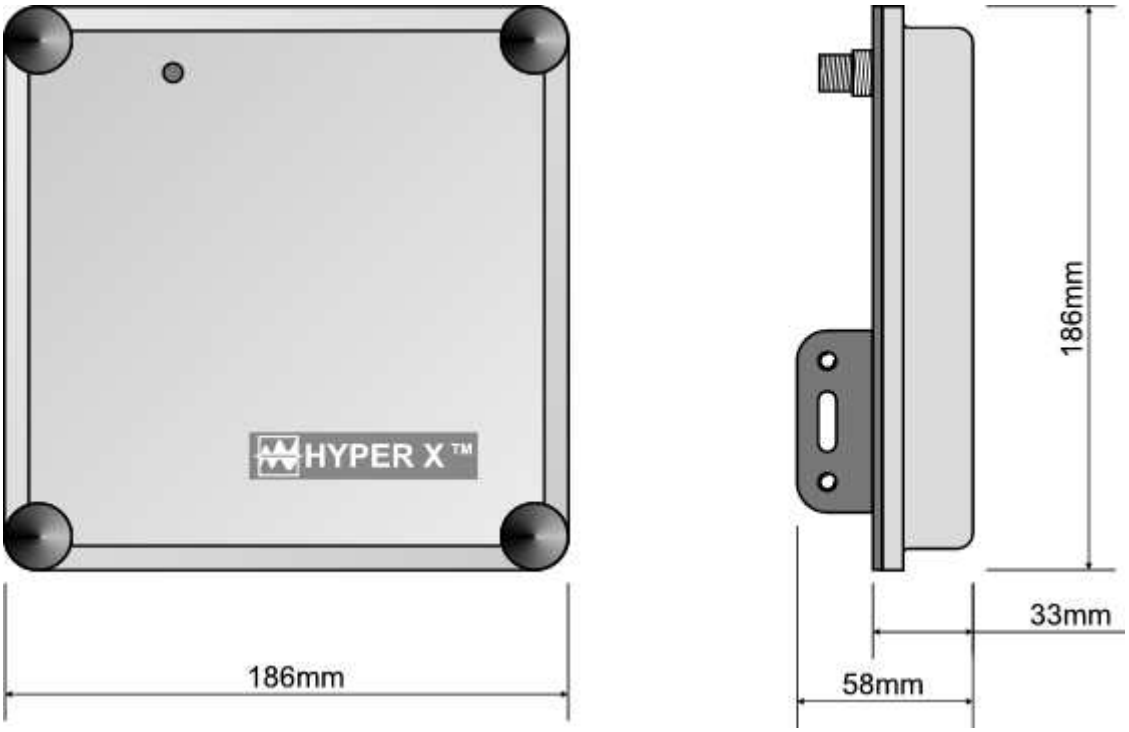
These readers are also equipped with:
• 1 An opto-coupled digital output that can be configured to switch either via a command sent from the host or automatically at each tag identification.
• 1 An opto-coupled digital input which can be used to globally enable or disable tag reading.

The readers must be powered with 12 - 24 VDC. A special detector ensures that if the input voltage is too low then the reader will not power up. Powering the reader from a mains outlet requires an AC adaptor of at least 18W.

2.4 MODELS AVAILABLE

Antenna polarisation Host Interface	Circular	Horizontal	Vertical
Wiegand 26 bits and DATA/CLOCK Input/Output USB	**MRU6882 TTL**	**MRU6883 H TTL**	**MRU6883 V TTL**
Wiegand 26 bits and DATA/CLOCK Input/Output RS 232, RS 422, RS 485 USB	**MRU6882 RS**	**MRU6883 H RS**	**MRU6883 V RS**
Wiegand 26 bits and DATA/CLOCK Input/Output RS 232, RS 422, RS 485 ETHERNET USB	**MRU6882 ETH**	**MRU6883 H ETH**	**MRU6883 V ETH**

2.5 OVERALL DIMENSIONS



3 DESCRIPTION OF OPERATION

3.1 DESCRIPTION OF READER

This document describes in detail the various interfaces of the MRU reader.
There are two sorts of interfaces: communication interfaces which use a protocol to send information to a host system, and digital interfaces which determine how tags are read (input) and what happens after identification (output).
There are two very different and physically separate communication interfaces, an open-collector interface for connecting to WIEGAND or magstripe (ISO 7811-2) controllers, and a serial asynchronous interface which can be configured as RS-232, RS-422, RS-485, USB or Ethernet.

The reader is equipped with a digital input for enabling or disabling tag reading, and a digital output (open collector) for controlling an external relay.

3.2 BASIC OPERATION

Two different operating modes are available for tag identification: automatic identification and identification-on-demand (see §5.3.1).

In automatic mode, when a tag is first detected by the reader, its code is stored in an internal memory buffer and remains there for at least a time Tr called persistence (see §5.3.2). At each detection a periodically-decremented timer is initialised and when the timer reaches 0 (no more detections after a certain time), the code is removed from the MRU reader's internal memory. At the first detection, a message for the host interface is generated. If the reader is in polling mode, this message is only sent on request from the host; in interrupt mode, the message is sent immediately. (RSxxx, USB or Ethernet). Further detections do not generate new messages, except if the reader is in message mode 2 (see §5.3.4).
Thus in general, for a tag that is placed in the reader antenna field and remains there, only one message is generated. The tag must be removed for a time greater than Tr in order for a second message to be generated. The default value for Tr is 1 second. This value can be modified.
Settings are stored in EEPROM non-volatile memory.

In the identification-on-demand mode, tag detection will take place only after the reader receives the appropriate MODBUS command. Two MODBUS commands are available, one is for single-tag detection (see §8.2.2) and the other is for multi-tag detection (see §8.2.3).

Once the tag has been detected, its internal memory can be accessed. Reading from and writing to the tag memory is done with the MODBUS commands "Read Tag Memory" (see §8.2.19) and "Write Tag Memory (see §8.2.18) respectively. Both these commands are available in both detection modes, automatic and on-demand.

The memory of a UHF EPC C1G2 tag is generally organised as 4 banks:
Bank "00" Reserved
Bank "01" EPC : This memory zone contains the tag's EPC code which is the tag's identification code, take great precautions before modifying this.
Bank "10" Tag Id: This zone is optional, it generally contains a code from the chip manufacturer and a model number for the chip. This is a read-only zone.
Bank "11" User memory: This zone, when it exists, is available for the user for both reading and writing. This is where user data will be stored.

3.3 SELF-TEST AFTER RESET

After a reset (or a power-up), the reader runs a self-test and performs a number of hardware checks.

During this time (a few seconds), the indicator light is red and the reader cannot detect tags.

At the end of this self-test, if no fault is detected, the antenna lamp flashes green.

If a critical error has been detected, the antenna light flashes red slowly and an error byte is available. The nature of the fault can be determined by means of MODBUS commands as long as the processor is still capable of responding. If the asynchronous serial link is in polling mode, this error code can be read with the command **read_init_errors.**

Error code (1 byte):

Bit	Description	Consequence
1		
2		
3	EEPROM	degraded (may be critical)
4		
5	Serial number	degraded
6	Serial Interface	degraded (may be critical)
7		
8	Air-link	critical

Examples of error codes:

Value	Cause
0x04	EEPROM
0x20	Serial Interface

If the serial interface test is enabled (TestLS=ON), then a message containing the firmware version is sent at the end of the self-test.

- In ASCII mode (see §7.4.2):

01.V.v0_4_5

- In MODBUS mode (trace in hexadecimal) (see §7.4.1):

02 04 07 54 76 30 5F 34 5F 35 28 E1

ASCII coding of version

If the serial link is in interrupt mode (Polling=OFF), then a message containing the reader configuration is sent at the end of the auto-test, just after the message containing the version.

- In ASCII mode (see §7.4.2):

01.S.C=0.1.2.1.1.0.0.0.3.0.0.0.01.0.0.0.0.2.0.1.0.19.0.0.0.1.0.1.01.1.1.0.0.00 v1

values for 34 setup parameters (see §5.2) Reader hardware version

- In MODBUS mode (ASCII codes for above values) (see §7.4.1):

02 04 2C 53 43 3D 30 31 32 31 31 30 30 30 33 30 30 30 30 31 30 30 33 30 32 30 31 30 31 39 30 30 30

values for 34 setup parameters (see §5.2)

31 30 31 30 31 31 31 30 30 30 30 20 76 31 30 E6

Reader hardware version

Note: the parameter n°16 (frame type) is different for the two traces above:
Frame type = ASCII ➔ param = 0
Frame type = MODBUS ➔ param = 3 (0x33 in ASCII)

3.4 INDICATOR LIGHT

The indicator light on the reader conveys the reader's behaviour to the user. It is the only visible part of the system. It is controlled by the embedded reader software. It can also be put under host control using appropriate MODBUS commands via a serial link.

During the initialisation phase, the light is continuous red. If the initialisation is successful, the indicator light starts to flash green, otherwise it flashes red very slowly.

If after power-on the light flashes quickly, this is usually caused by a power supply problem, either voltage or current is insufficient. This is not a fault condition, but an indication that a better-dimensioned power supply must be used.

During the reading of a tag, the indicator light goes out for one second, then resumes green flashing.

4 CONNECTORS AND INTERFACES

All the reader's connectors are found on the rear panel.
All connectors are panel mounts using the M12 standard.
Moulded cable assemblies of different lengths are available from several manufacturers.
Manual assembly of cable connectors allows choosing between soldered, crimped or screw-terminal connections.

CAUTION: these M12 type connectors are designed for hand-tightening only. Spanners or pliers must not be used or else damage may occur.

Connector numbers (rear view MRU)

1 2 3 4 5

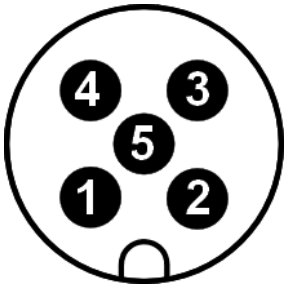
The reader model MRUxxxx ETH has three serial data interfaces: USB, ETHERNET, RS. These three cannot operate simultaneously, only one at a time can be used. Selection is done automatically when cables are connected, according to the following priority:

USB > ETHERNET > RS

The USB interface has priority over the ethernet interface, so the USB cable must be removed in order to use the ethernet interface. Similarly, the ethernet interface has priority over the RS interface, so the ethernet cable must be removed in order to use the RS interface.

4.1 CONNECTOR N°1: POWER AND OPEN-COLLECTOR INTERFAC E

M12 plug, A-coding, male, 5 pins.
Connector pinout, front view:



	POWER	Open-collector	
		DATA/CLOCK	WIEGAND
1	+DC		
2		DATA	DATA “0”
3		CLOCK	DATA “1”
4	OV		
5		GND	GND

The cable connector must be type M12 A-coding, female, 5 pins.
This connector is available in the corresponding ACS8320 accessory kit.
A cable with a M12 connector is also available as an accessory.

This connector has 2 functions: reader power supply and open-collector interface for DATA/CLOCK and WIEGAND

4.1.1 READER POWER SUPPLY

The reader requires a DC power supply of between 12Vdc and 24Vdc applied between pins 1 and 4 of the connector.
Current drawn is 1.5 A maximum during power-up surge.

Average currents for steady-state operation in automatic detection mode at maximum power are given in the following table:

+DC	MRUxxxx RS/TTL	MRUxxxx ETH
12V	530 mA	580 mA
24V	290 mA	340 mA

The reader electronics are protected against polarity inversion for the power supply connection.

Pay careful attention to the length and gauge of the wire used. As ohmic losses in the power lead can cause a voltage drop, make sure the input voltage to the reader is greater than 11.5V.

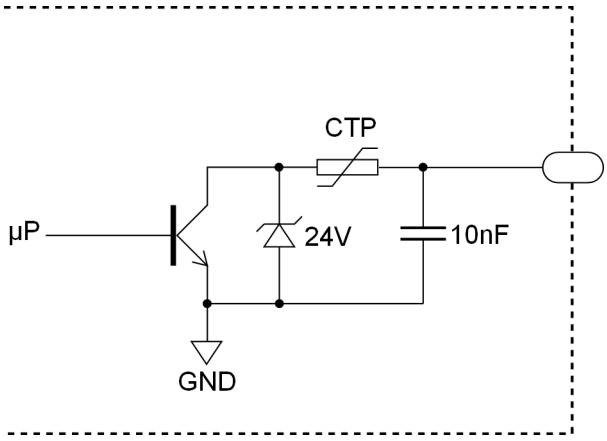
If the power supply cannot provide sufficient current during the power-up, the front-panel light will blink red. This is not a fault condition, but an indication that a better-dimensioned power supply must be used.

4.1.2 OPEN-COLLECTOR LINK:

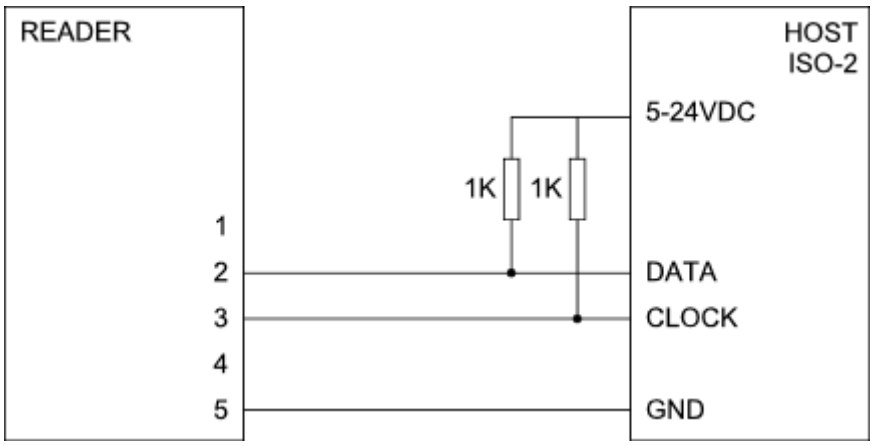
Different signals appear on the pins depending on which interface is selected.

pin	DATA/CLOCK	WIEGAND
1		
2	DATA	DATA “0”
3	CLOCK	DATA “1”
4		
5	GND	GND

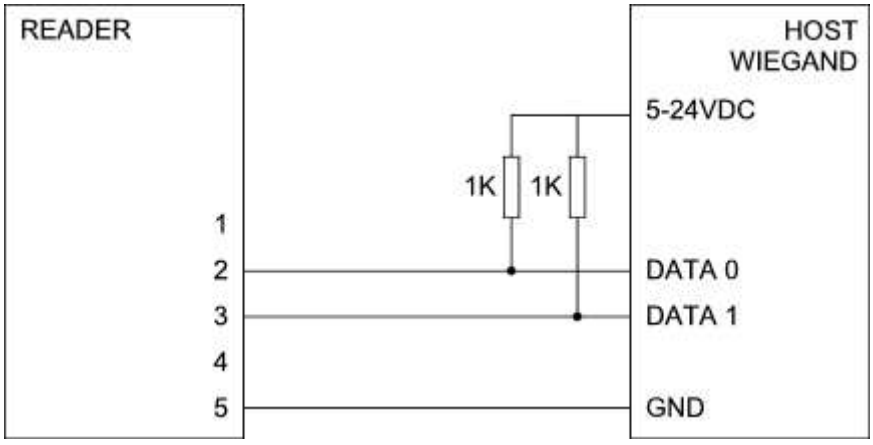
- **Circuit diagram for open-collector output:**



- **reader connections for DATA-CLOCK:**

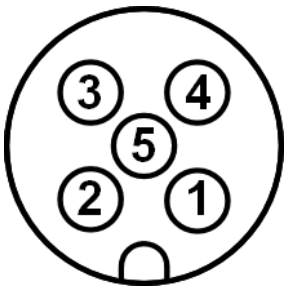


- **reader connections for WIEGAND:**



4.2 CONNECTOR N°2: INPUT/OUTPUT

M12 plug, A-coding, female, 5 pins.
Connector pinout, front view:

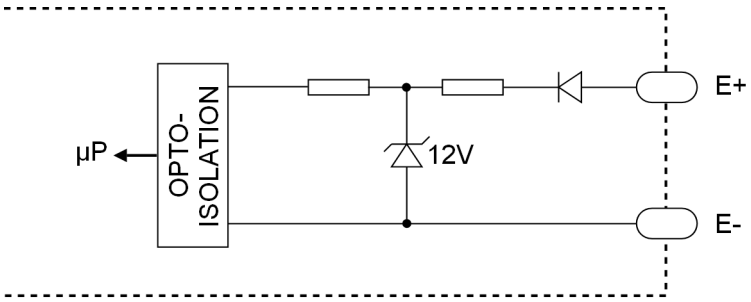


1	E+	INPUT
2	E–	
3	SV	OUTPUT
4	S+	
5	S–	

The cable connector must be type M12 A-coding, male, 5 pins.
This connector is available in the corresponding ACS8320 accessory kit.
A cable with a M12 connector is also available as an accessory.
A 4-pin connector can be used if the output is not used.

4.2.1 INPUT

Circuit diagram for digital input:

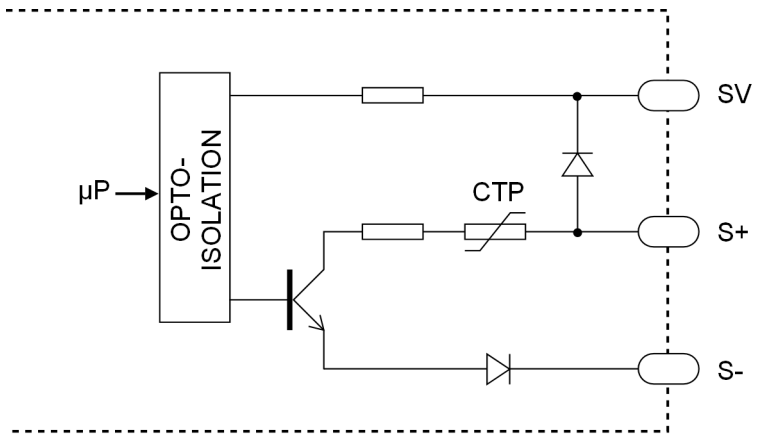


The digital input uses an opto-coupler to provide galvanic isolation from the reader electronics. An open circuit or a positive voltage less than 4.4V applied to the pin E+ will produce the internal logic state "1", a voltage between 7.1V and 24V will produce the state "0". This input is sampled and the state updated every 50ms. If the applied voltage is greater than 7.1V, the bit E1 of the status word is reset to 0. During normal operation, the applied voltage should not be above 24V.

This input allows enabling or disabling tag reading, e.g. when a loop vehicle detector provides a control signal.

4.2.2 OUTPUT

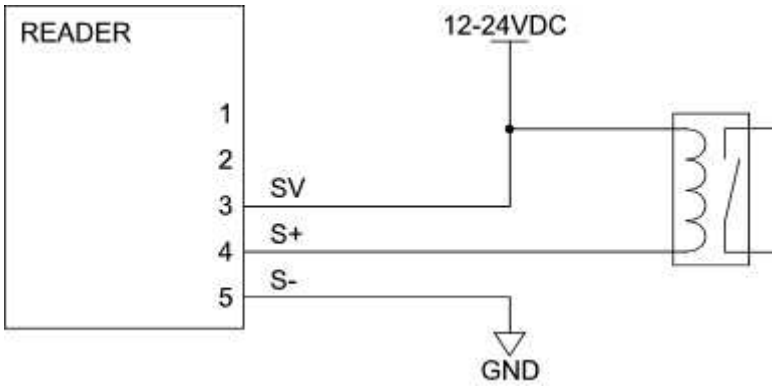
Circuit diagram for digital output:



The digital output uses an opto-coupler to provide galvanic isolation from the reader electronics. Enabling the output turns the output transistor and current is drawn from an external voltage applied on the SV pin. The load is connected between pins S+ and SV. The collector current will induce a voltage of about 1V between these two pins.
If the output is disabled, the transistor is turned off and the voltage on pin S+ will be equal to that on pin SV.

This output is designed to control a 12V or 24V relay. The current available is typically 100mA.

4.2.3 TYPICAL WIRING DIAGRAM FOR CONNECTING A BUZZER OR RELAY:



4.3 CONNECTOR N°3: ASYNCHRONOUS SERIAL LINK

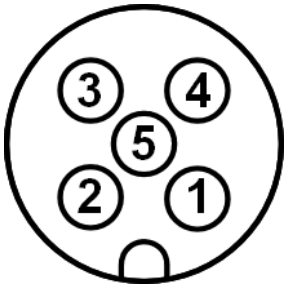
This connector is only present in the MRUxxxx ETH and MRUxxxx RS models

The reader model MRUxxxx ETH has three serial data interfaces: USB, ETHERNET, RS. These three cannot operate simultaneously, only one at a time can be used. Selection is done automatically when cables are connected, according to the following priority:

USB > ETHERNET > RS

In order to use the RS interface it is necessary to disconnect any cables on the ethernet and USB connectors.

M12 plug, A-coding, female, 5 pins.
Connector pinout, front view:



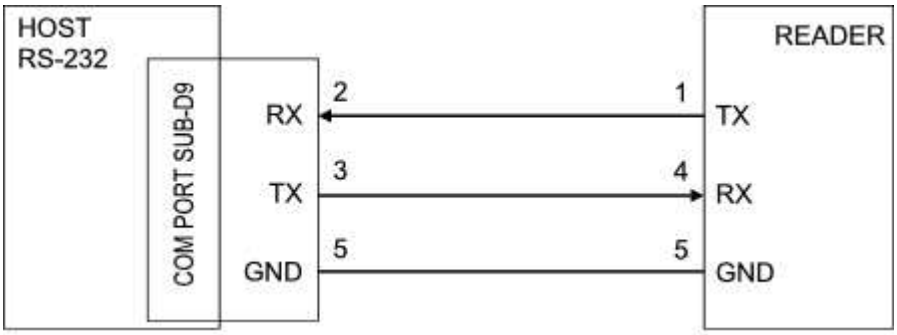
pin	RS-232	RS-422	RS-485
1	TX	TX+	V1+
2	—	TX–	V1–
3	—	RX+	V2+
4	RX	RX–	V2–
5	GND	GND	GND

The cable connector must be type M12 A-coding, male, 5 pins.
This connector is available in the corresponding ACS8320 accessory kit.
A cable with a M12 connector is also available as an accessory.

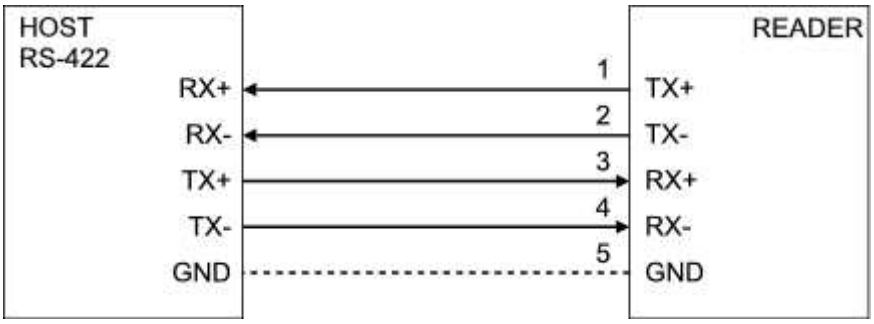
Different signals appear on the pins depending on which interface is selected.

4.3.1 WIRING DIAGRAMS FOR HOST CONNECTIONS

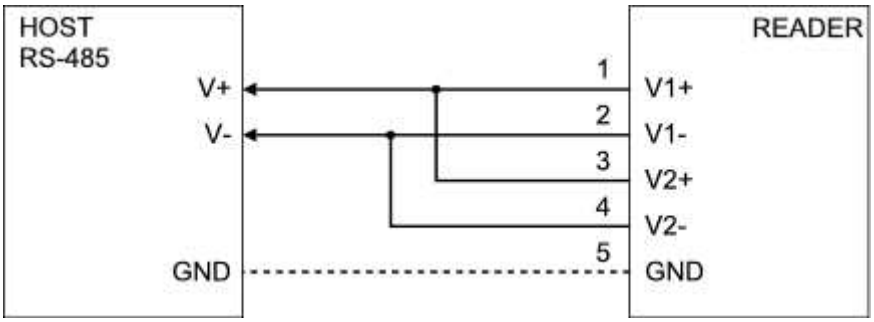
Reader connections for RS-232:



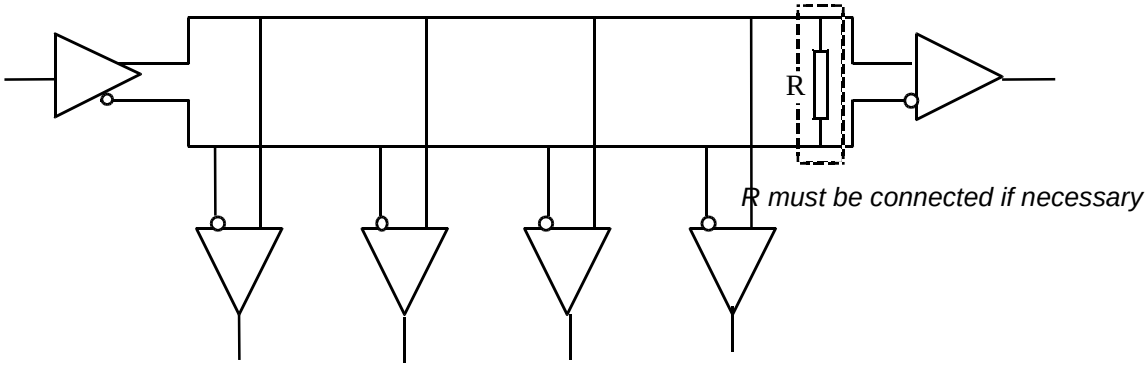
Reader connections for RS-422 (full-duplex):



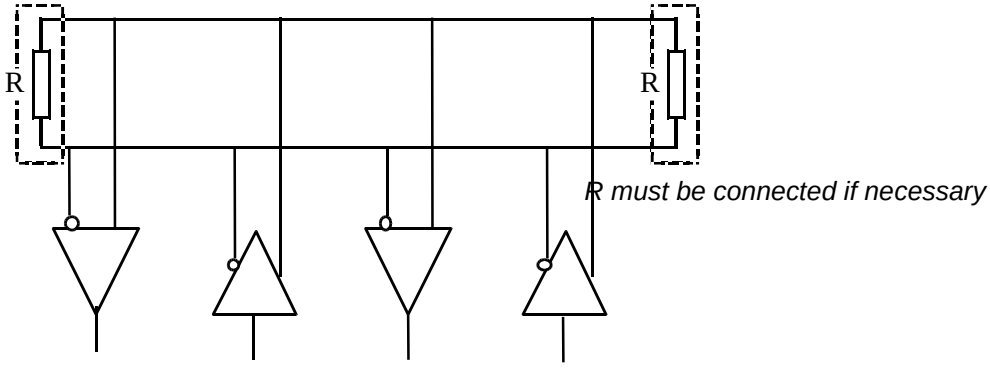
Reader connections for RS-485 (half-duplex):



Network connections (bus, simplex).



Network connections (bus, half-duplex).



4.3.2 ELECTRICAL CONNECTIONS

Cables to use for RS-422 and RS-485 links

- In the absence of electrical noise - unshielded twisted pairs.
- In a noisy environment - individually shielded twisted pairs

Cables are characterised by:
- their characteristic impedance (Z0 in ohms)
- their distributed capacity (CL in pF/m).
- their distributed resistance (RL in ohms/m)

For short cable lengths, normal cables are satisfactory.
For cables longer than 100 m, high quality cables (low CL and RL) should be used for all transmission speeds.

Signal inversions

For an RS-232 link, signal polarities and levels are well defined. On both devices RX is connected to TX and vice-versa.

For an RS-422 or RS-485 link, the signal “+” is normally at a high level at rest and active low, the reverse is true for the signal "–". This is the case for this reader. If however the differential signals are generated by a converter from an RS-232 interface, then the “+” line can be at a low level at rest and active high. In this case, the signals must be inverted.

Half-duplex interface

In the case of an RS-485 “2-wire” (half-duplex) link, the signals V1+ and V2+ must be connected together and connected to the V+ pin on the host device. Similarly, the signals V1– and V2– must be connected together and connected to the V– pin on the host device.

Connection of GND

For an RS-232 link, the GND of each equipment must be at the same potential. Consequently, the signal GND (pin 5 on connector) must be connected to the chassis of the host equipment. For a differential link, this GND connection is not absolutely necessary but often recommended.

Line termination

For bit rates not greater than 1200bps, no termination is necessary. For bit rates greater than 9600bps and line lengths greater than a few hundred metres, a resistor equal to the line impedance (≈120 ohms) is essential.
For a simplex link (one-way), the termination (if present) should be placed at the receiving end..
For a duplex link (two-way), the termination (if present) should be placed at each end of the line.

Line biasing

For RS-422 and RS-485 links, biasing may be necessary. This is done externally and only at one point on the line.

The line “+” is connected to +5V via a 4.7K resistor.
The line “–” is connected to GND via a 4.7K resistor.

4.4 CONNECTOR N°4: USB

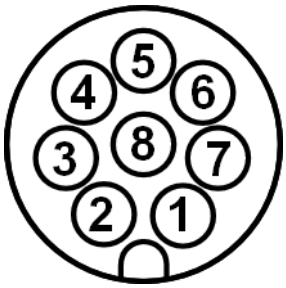
The reader model MRUxxxx ETH has three serial data interfaces: USB, ETHERNET, RS. These three cannot operate simultaneously, only one at a time can be used. Selection is done automatically when cables are connected, according to the following priority:

USB > ETHERNET > RS

In order to use the RS interface it is necessary to disconnect any cables on the ethernet and USB connectors.

The USB interface has priority over the other interfaces, so the USB cable must be removed in order to use the ethernet or RS interfaces.

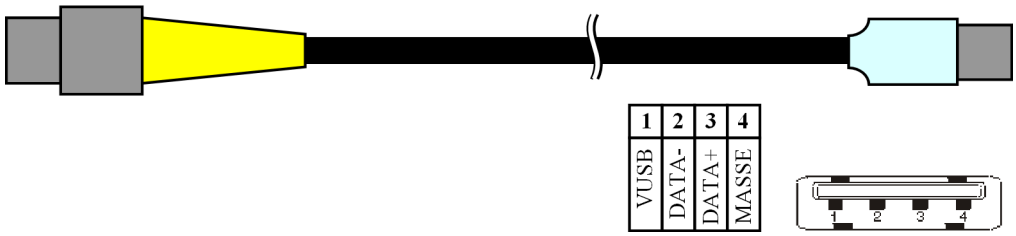
M12 plug, A-coding, female, 8 pins.
Connector pinout, front view:



1	VUSB (+5V)	USB
2	DATA-	
3	DATA+	
4	CHASSIS	
5	do not connect	RESERVED (TEST)
6	do not connect	
7	do not connect	
8	do not connect	

The cable connector must be type M12 A-coding, male, 8 pins.
This connector is available in the corresponding ACS8320 accessory kit.

We recommend using a cable less than 2m in length.
A cable with a M12 connector is also available as an accessory for connecting the MRU to a PC via the USB interface:



4.5 CONNECTOR Nº5: ETHERNET

This connector is only present in the MRUxxxx ETH model

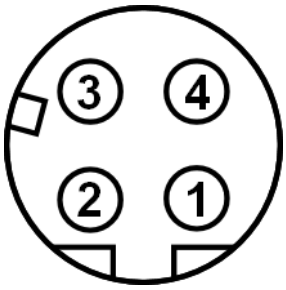
The reader model MRUxxxx ETH has three serial data interfaces: USB, ETHERNET, RS. These three cannot operate simultaneously, only one at a time can be used. Selection is done automatically when cables are connected, according to the following priority:

USB > ETHERNET > RS

In order to use the ethernet interface it is necessary to disconnect the USB cable.

The ethernet interface has priority over the RS interface, so the ethernet cable must be removed in order to use the RSinterface

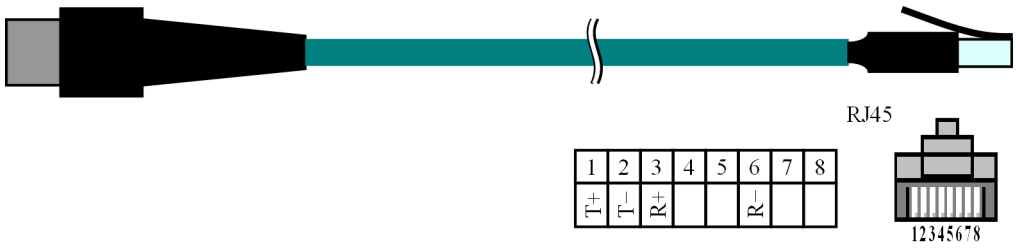
M12 plug, A-coding, female, 4 pins.
Connector pinout, front view:



1	T+
2	R+
3	T–
4	R–

The cable connector must be type M12 A-coding, male, 4 pins.
This connector is available in the corresponding ACS8320 accessory kit.

A cable with a M12 connector is also available as an accessory for connecting the MRU to an Ethernet network:



5 READER SETTINGS

5.1 INTRODUCTION

Reader configuration is done by means of commands sent over the serial link (see §8).
This can be done at any time but, naturally, requires that the transmission/network is correctly configured.

5.2 TABLE OF PARAMETERS

All of the parameters in the table are saved in the non-volatile memory. The number in the second column gives the order in which they are memorised.

Parameter		Value	stored as	Default value	Notes
Reserved	1			1	
Automatic Detection	2	OFF	0		
		ON	1	1	
Persistence	3	0.1s	0		
		0.5s	1		
		1s	2	2	
		2s	3		
		5s	4		
		10s	5		
Reserved	4			1	
Reserved	5			1	
Reserved	6			2	
Indicator light	7	NORMAL	0	0	
		TEST	1		
		OTHER	2		
		HOST	3		
Message mode	8	0	0	0	
		1	1		
		2	2		
		3	3		
Reserved	9			3	
Reserved	10			0	
RS interface type	11	RS232	0	0	
		RS422	1		
		RS485	2		
Open-collector interface	12	not used	0	0	
		ISO2 fixed	1		
		ISO2 variable	2		
		WIEGAND	3		
MODBUS address	13	1 to 31	1 to 31	1	
Data rate	14	9600	0	0	
		4800	1		
		1200	2		
		19200	3		

Parameter		Value	stored as	Default value	Notes
Character format	15	8 bits no parity	0	0	
		7 bits even parity	1		
		7 bits odd parity	2		
Frame type	16	ASCII	0	0	ASCII with header
		code only	1		ASCII without header
		reserved	2		
		MODBUS	3		
Polling/Interrupt	17	Interrupt	0	0	
		Polling	1		
MTBM*	18	0.1s	0		
		0.2s	1		
		0.5s	2	2	
		1s	3		
		2s	4		
Nb emissions	19	1 to 4	0 to 3	0	nb emissions in interrupt
Output	20	not used	0		
		Tag detection	1		
		ident 2s	2	2	
		host	3		
		reserved	4		
		reserved	5		
		reserved	6		
		reserved	7		
Reserved	21			0	
Power	22	Minimum Power	0		
			1		
			2		
			3		
			4		
			5		
			6		
			7		
			8		
			9		
			10	10	
			11		
			12		
			13		
			14		
		Maximum Power	15		
Reserved	23			0	
Input	24	disabled	0	0	
		reading	1		tag reading enabled
Reserved	25			0	

Parameter		Value	stored as	Default value	Notes
reserved	26			4	
Test carrier	27	Normal	0	0	
		Stop	1		
		CW carrier	2		
		Modulated carrier	3		
Test serial interface	28	OFF	0	0	
		ON	1		
Detection period	29	1 ms	0		
		2 ms	1		
		3 ms	2		
		4 ms	3		
		5 ms	4		
		6 ms	5		
		7 ms	6		
		8 ms	7		
		9 ms	8		
		10 ms	9		
		20 ms	10	10	
		40 ms	11		
		60 ms	12		
		80 ms	13		
		100 ms	14		
		500 ms	15		
		1000 ms	16		
		2000 ms	17		
		5000 ms	18		
		10000 ms	19		
Reserved	30			1	
Reserved	31			1	
Reserved	32			0	
Reserved	33			0	
Nb of tags present	34	1	0	0	Single-tag Mode
		1 to 3	1		Multi-tag Mode The values indicated are approximate
		3 to 6	2		
		6 to 11	3		
		11 to 22	4		

* MTBM = Minimum Time Between Messages

5.3 DESCRIPTION OF PARAMETERS

5.3.1 AUTOMATIC DETECTION

In this mode the reader is continuously searching for tags (see §3.2). The time between two interrogations is given by parameter n°29 "Detection period". The detected tags are stored in the reader's internal memory (see below).

5.3.2 PERSISTENCE

The time a tag remains in internal memory after its previous detection, therefore the minimum time during which it needs to remain undetected in order to be detected again.

5.3.3 INDICATOR LIGHT

Determines the behaviour of the front-panel light. Currently, two modes are defined:

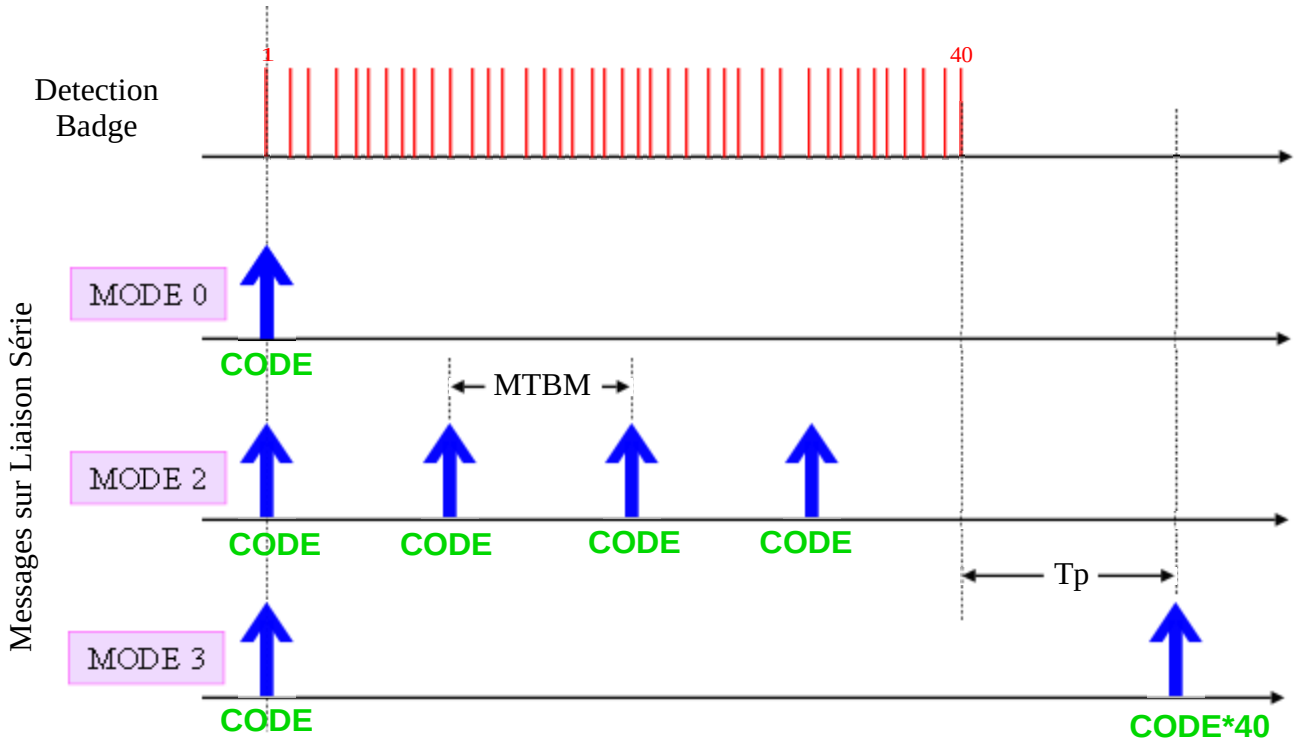
event	normal	test
tag detection	light goes out for 1 s	red flash 50ms
operation OK	green flashing 3 times/second	steady green
fault detected	red flashing once a second	green flashing 10 times/second

5.3.4 MESSAGE MODE

Determines how messages are sent over the serial link, the choices being:
- mode 0 (message sent each time a new tag is detected)
- mode 1 (reserved for special use)
- mode 2 (messages sent periodically while tag is present)
- mode 3 (mode 0 plus disappearance message).

For mode 2, the time between two transmissions is determined by parameter N° 18 (MTBM). **This mode is only used together with the interrupt mode (parameter N°17 = 0).**
In mode 3, the disappearance message is generated a certain time (Tp) after the last tag detection, where Tp is given by parameter N° 3 (persistence). The disappearance message is the same as the appearance message, with the three characters *NN added, where NN is the number of times this tag has been detected.

The diagram below shows the messages generated in these modes for a tag that has been detected 40 times:



5.3.5 RS INTERFACE TYPE

Allows choosing the type of RS interface: 232, 422 or 485. To use it as the host interface, select "nu" (not used) for the open-collector interface (see next paragraph).

5.3.6 OPEN COLLECTOR INTERFACE TYPE

Defines one of the open-collector interfaces as the host interface.
If the host interface is the RS interface, select "nu" (not used).

5.3.7 MODBUS ADDRESS

The reader address when the reader is on a network. For a reader on its own, leave unchanged.

5.3.8 ASYNCHRONOUS SERIAL LINK TRANSMISSION SPEED

Selects the transmission speed for the host interface (RS232, RS422, RS485 and virtual COM port for USB and Ethernet).

5.3.9 CHARACTER FORMAT

When using MODBUS frames choose 8 bits/no parity; for ASCII or Code Only, select according to host interface.

5.3.10 FRAME TYPE

Defines the format of the message transmitted following detection of a tag. For example, for the tag 0x3005FB63AC1F3841EC880467:
In polling mode, choose MODBUS :

message = 01 03 0E 31 30 05 FB 63 AC 1F 38 41 EC 88 04 67 00 CC 91

In interrupt mode, the choices are:

MODBUS, message = 02 04 0D 31 30 05 FB 63 AC 1F 38 41 EC 88 04 67 C6 BD

ASCII, message = 01.1. 0x3005FB63AC1F3841EC880467

Code only, message = 0x3005FB63AC1F3841EC880467

5.3.11 POLLING

Allows selecting the manner in which a tag code is transmitted to the host interface. With polling OFF (interrupt mode), the detection of a new tag generates a message which is immediately sent to the interface. With polling ON, this message is only sent in response to the MODBUS command "Read tag". If the reader does not receive this command during the time the tag is present, the message is lost.

5.3.12 MTBM

Defines the Mean Time Between Messages between two transmissions on the open-collector interface or in interrupt mode, whether they be messages for different tags or repetitions of the same message (see also the next chapter).

5.3.13 NUMBER OF TAG-CODE TRANSMISSIONS

For asynchronous interface, in interrupt mode, the maximum number of transmissions of the same tag code if no ACK is received.
For open-collector interface, if the value is greater than one, then the message is repeated. The time between messages is given by the MTBM value (previous parameter).

5.3.14 OUTPUT

Defines the behaviour of the digital output The values are:

Case	Value	Description
not used	0	
Tag detection	1	Activation at each detection of a valid tag code
2 s	2	Activation for 2s after detection of a new tag
Host	3	Controlled by MODBUS commands
reserved	4	
reserved	5	
reserved	6	
reserved	7	

5.3.15 POWER

Allows choosing between 15 values of UHF power, from 0 (min power) to 15 (max power).

5.3.16 INPUT

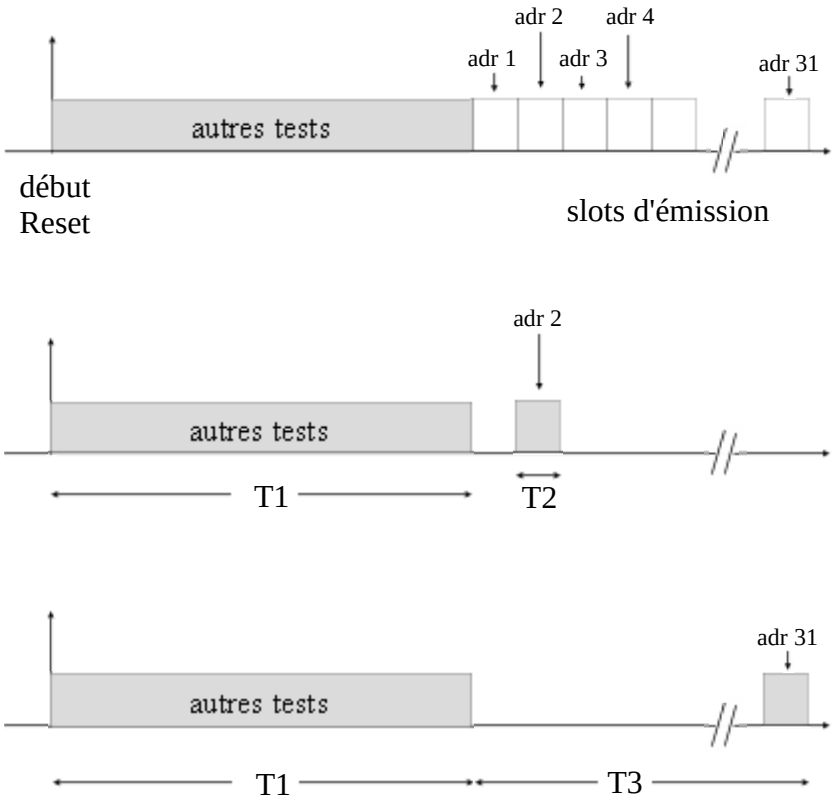
Allows enabling or disabling the reading of tags using the digital input
Upon activation of the input (Vin > 7.1V), tag identification is enabled.
Upon deactivation of the input (Vin < 4.4V), identification is disabled.

5.3.17 TEST CARRIER

Allows generating a carrier, either CW or modulated, for testing and measurement purposes. Must not be changed.

5.3.18 SERIAL LINK TEST

Allows a test of the reader's serial interface by sending a test message with the output looped back onto the input. In RS232 and RS422 this loop-back is done within the interface chip. In RS485 it must be done by external cabling at the connector.
In RS422 and RS485 this test lasts approximately 3 seconds (T3 below), as it must be able to function in a network topology in which up to 30 readers can be connected on the same bus. In this case, in order to avoid collisions between the transmissions from the various readers, a 100ms slot is allocated to each reader in accordance with its address on the bus.



5.3.19 DETECTION PERIOD

A pause, from 1ms to 10s, between two successive interrogations in automatic-detection mode (parameter n°2).

5.3.20 NB OF TAGS PRESENT

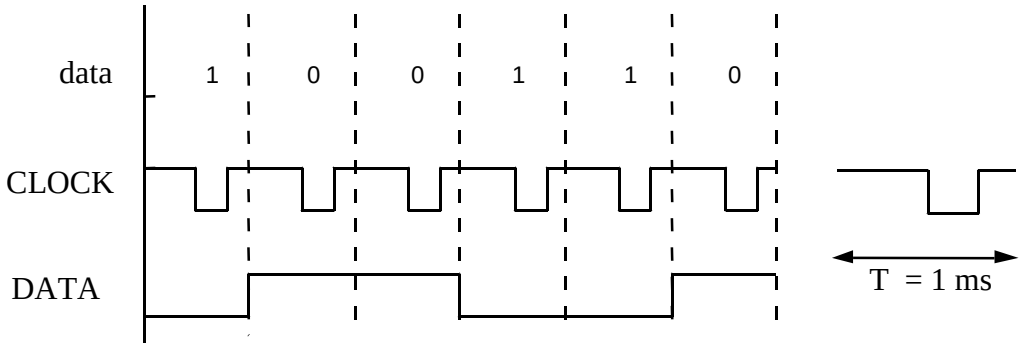
Defines the number of tags (approximately) that need to be detected at the same time.

6 OPEN-COLLECTOR TYPE INTERFACES

6.1 MAGNETIC STRIPE CARD INTERFACE "ISO2" (CLOCK/DATA)

6.1.1 DESCRIPTION

Using this interface allows the MRU reader to take the place of a standard magnetic stripe card reader (ISO 7811-2). The standard electrical “ISO2” interface contains two signals, **CLOCK** and **DATA** . The **DATA** signal has negative logic and the **CLOCK** validation signal is active low during each data bit (see below). The transmission is synchronous, at a speed of approximately 1000 bits/s.
Timing of the signals for the ISO2 interface (the data period is 1 ms):



6.1.2 MESSAGE FORMAT

Messages contain a prefix of 15 zeros for the synchronisation needs of the receiver, the data frame described below, then followed by 10 zeros.
The data is formatted in characters of 5 bits– 4 bits for binary coding plus one odd parity bit. The four data bits of each character allow the coding of 0 to 9 and the six capital letters A to F. The data characters are preceded by a start character, followed by an end character and a checksum character:

ISO2 Code			
1 character	n character	1 character	1 character
START	Data	END	LRC

The checksum character (LRC) is the “exclusive or” function applied to all characters from START to END inclusive . This character itself contains an odd parity bit.
Each character is issued LSB first and the parity bit at the end. For example, the data ‘3’ is coded 0011 with a parity bit of 1 and these bits are issued in the order 1 1 0 0 1.
The binary coding of the character DEB = 0xB, the binary coding of the character END = 0xF.
The contents of the “data” field depend on the type of operation and the length selected. In the case of a frame of variable length, this field corresponds to the user data programmed into the tag. In the case of the fixed length frame, this field contains exactly 37 characters, the filling character at the end of the tag ID code being 0xD.
If message mode 3 has been selected, a further message is issued when each tag disappears. The special character that separates the tag's code and the number of detections is 0xC.

Some examples for the data field

Message mode 0, variable length:

ISO2 code	length = 3 + n

Message mode 3, variable length:

ISO2 code	0xC	nb detections	length = 3 + n + 1 + 2

Message mode 0, fixed length:

ISO2 code	0xD	0xD	...	0xD

length = 37

Message mode 3, fixed length:

ISO2 code	0xC	nb det	0xD	0xD	...	0xD

length = 37

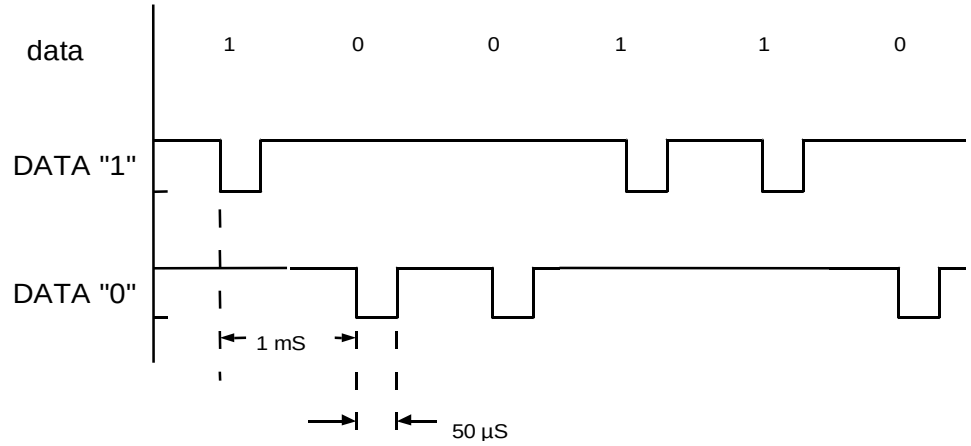
6.1.3 MESSAGE TRANSMISSION

Transmission of the tag ID code towards the external system can be regulated by two further parameters, the minimum time between two messages (MTBM) and repetition of the message.
The MTBM can take five different values, from 0.1s to 2s, allowing interfacing to systems which have different reaction times.
Repetition of the message may be necessary for certain links. In this case, retransmission takes place after the MTBM time.

6.2 WIEGAND EFFECT TAG INTERFACE

6.2.1 DESCRIPTION

This interface allows the HYPERX reader to take the place of a substitute for a WIEGAND reader. The interface contains two signals, "DATA 0" and "DATA 1". The logic zeros appear as negative impulses on the "DATA 0" signal and the ones as negative impulses on the "DATA 1" signal. The timing of the signals is shown below. The transmission is synchronous at a speed of approximately 1000 bits/s.



6.2.2 MESSAGE FORMAT

The message transmitted onto the interface has a fixed length of 26 bits, with the following structure:

EP - even parity bit
The value of the bit is the even parity calculated on bits 2 to 13.

FC - Facility Code
Length = 8 bits (bits 2 to 9)
This is a number coded on 8 bits (0 to 255), the MSB is bit 2.

CC - Card Code
Length = 16 bits (bits 10 to 25)
This is a number binary-coded as 16 bits (0 to 65535), the MSB is bit 10.

OP - odd parity bit
The value of the bit is the odd parity calculated on bits 14 to 25.

Bit 1 is the first bit transmitted onto the interface.

6.2.3 MESSAGE TRANSMISSION

Transmission of the tag ID code towards the external system can be regulated by two further parameters, the minimum time between two messages (MTBM) and repetition of the message.

The MTBM can take five different values, from 0.1s to 2s, allowing interfacing to systems which have different reaction times.

Repetition of the message may be necessary for certain links. In this case, retransmission takes place after the MTBM time.

7 RS-XXX ASYNCHRONOUS SERIAL INTERFACES

7.1 INTRODUCTION

Only one of the three interfaces USB, Ethernet or RSxxx can be used at any one time. The USB interface has priority over the ethernet interface, so the USB cable must be removed in order to use the ethernet interface. Similarly, the ethernet interface has priority over the RS interface, so the ethernet cable must be removed in order to use the RS interface.
Between reader and host, two types of connection are possible: point-to-point or multipoint. Two types of protocol are also possible: polling (MODBUS compatible frames) or interrupt.
The interrupt protocol can only be used with point to point connections.
A multipoint or network connection, in accordance with standard RS-485 (2 wire) or RS-422 (4 wire), is used when the installation must include several readers (or readers plus a tag-programming device). Messages are exchanged by means of polling in accordance with the MODBUS protocol.
When the installation only has one reader, the point to point connection can be used, either in interrupt or in polling mode (see §7.5). In interrupt mode, there is a choice between the ACK/NAK protocol with MODBUS type frames, or messages in ASCII without a protocol.
The table below summarizes the different types of connection:

Protocol	**Type of connection**	
	point to point	multipoint
Interrupt (ASCII or MODBUS)	RS-232/422/485, USB, Ethernet	—
Polling (MODBUS)	RS-232/422/485, USB, Ethernet	RS-422 or RS-485, USB, Ethernet

7.2 TRANSMISSION CHARACTERISTICS

For all the interfaces (RSxxx, USB or Ethernet), transmission is serial and originates in the internal UART of the processor (Blackfin).

The transmission protocol is based on the character.
The possible formats are:

- 7 bits even parity / 1 stop bit
- 7 bits odd parity / 1 stop bit
- 8 bits no parity / 1 stop bit

Several transmission speeds are possible :

- 1,200 bits/s
- 4,800 bits/s
- 9,600 bits/s
- 19,200 bits/s

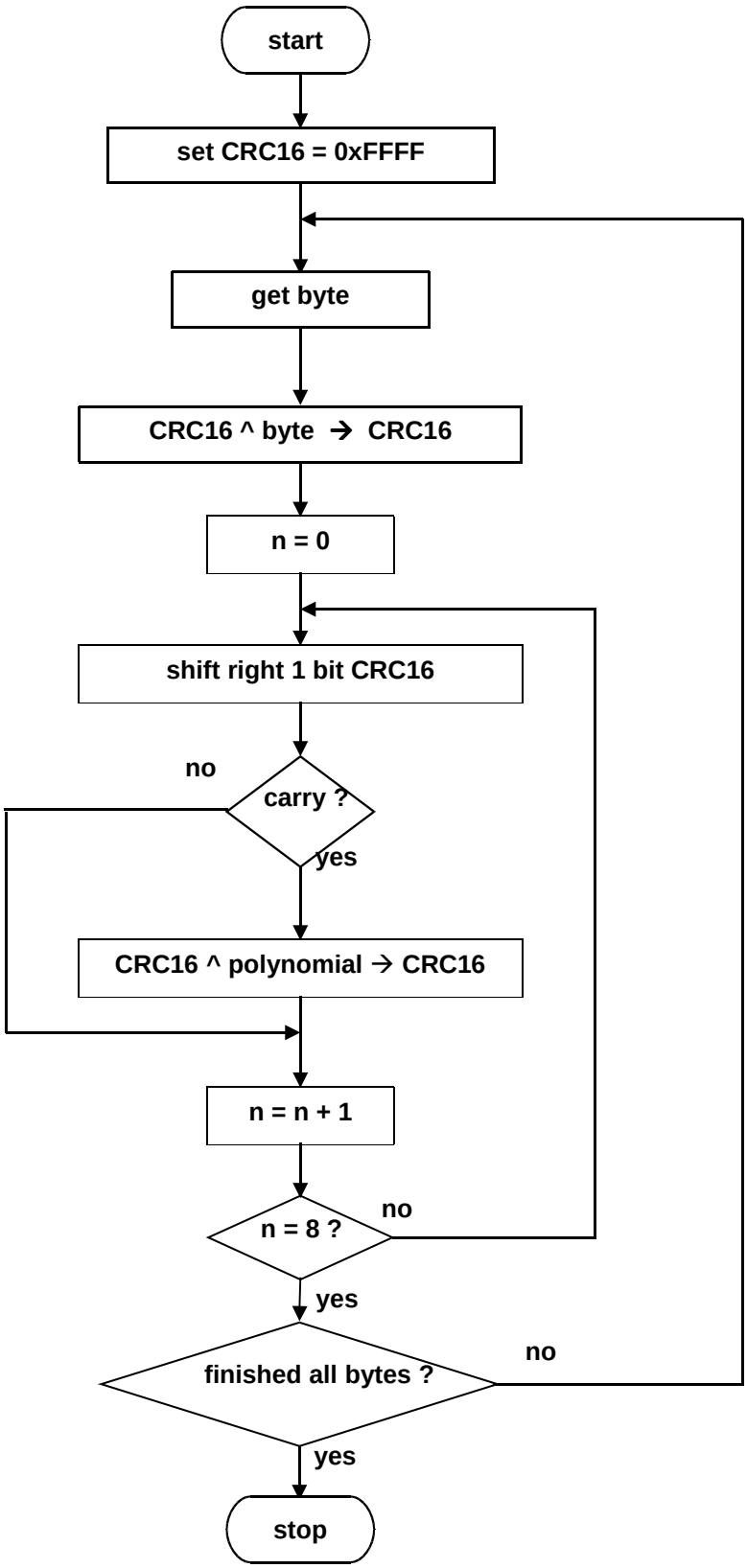
➔ In practice, the MODBUS binary protocol, as used here, requires the 8 bit format without parity. The other formats apply in ASCII/interrupt mode.

7.3 FRAME CONTROL WITH CRC16

All message frames contain a control word calculated according to the CRC16 algorithm

Polynomial: $X^{16} + X^{15} + X^2 + 1 \rightarrow 0x8005$ (mirror of 0xA001)
Initial value: 0xFFFF

Flowchart for calculation:



7.4 INTERRUPT PROTOCOL

In interrupt mode, the user can choose between a binary format and two ASCII formats. The selection is made with the parameter n°16 "Frame type"

7.4.1 THE BINARY FORMAT

The binary format uses MODBUS type frames. The format is as follows:

		1 byte	1 byte	n bytes	1 or 0 bytes	2 bytes
02	04	nb characters (n)	antenna	ID	0x00	CRC16

The frame control field (CRC16) is calculated using the algorithm given in the previous chapter. The result is a 16-bit word which is transmitted in the order: LSB to MSB.
After the frame is sent, the reader waits for an ACK (06) character. If it has not received an ACK after 100ms, it re-transmits the frame up to NE times, where NE = parameter (n°19) number of emissions.

Example 1: Tag coded in “raw” mode, 12 bytes

02 04 0D 31 42 41 4C 4F 47 48 20 37 35 30 31 38 0B C4

(nb characters = 0x0D=13, Antenna= “1”, ID code= “ 42414C4F4748203735303138 ”)

Example 2: Tag coded in ASCII mode, 13 ASCII characters

02 04 0E 31 42 41 4C 4F 47 48 20 37 35 30 31 38 20 C7 1E

(nb characters = 0x0E=14, Antenna= “1”, ID code= “ 42414C4F474820373530313820 ”)

7.4.2 ASCII FORMATS

7.4.2.1 ASCII

The first ASCII format (known simply as ASCII) sends the following character sequence:

<reader_address>.<antenna>.0x<ID>CRLF coded tag for "raw" mode
<reader_address>.<antenna>.<ID>CRLF coded tag for ASCII mode

where reader_address : ‘1’-‘31’ = addresses from 1 to 31
antenna : "1" = antenna 1
ID code : 12 bytes = 24 bytes in ASCII, coded tag for "raw" mode
12 bytes, coded tag for ASCII mode

Example 1: Tag coded in “raw” mode, 12 bytes = 24 bytes in ASCII

30 31 2E 31 2E 30 78 34 32 34 31 34 43 34 46 34 37 34 38 32 30 33 37 33 35 33 30 33 31 33 38 0D 0A

Reader address = 01
Antenna = 1
ID code = 42 41 4C 4F 47 48 20 37 35 30 31 38
ASCII ID code = 34 32 34 31 34 43 34 46 34 37 34 38 32 30 33 37 33 35 33 30 33 31 33 38

Example 2: Tag coded in ASCII mode, 13 ASCII characters

30 31 2E 31 2E 42 41 4C 4F 47 48 20 37 35 30 31 38 20 0D 0A

Reader address = 01
Antenna = 1
ID code = «BALOGH 75018 »

7.4.2.2 ASCII CODE ONLY

The second ASCII format (known as CODE_ONLY) only transmits the tag ID code.

0x<ID> coded tag for "raw" mode
<ID> coded tag for ASCII mode

Example 1: Tag coded in “raw” mode, 12 bytes = 24 bytes in ASCII

30 78 34 32 34 31 34 43 34 46 34 37 34 38 32 30 33 37 33 35 33 30 33 31 33 38

ID code = 42 41 4C 4F 47 48 20 37 35 30 31 38
ASCII ID code = 34 32 34 31 34 43 34 46 34 37 34 38 32 30 33 37 33 35 33 30 33 31 33 38

Example 2: Tag coded in ASCII mode, 13 ASCII characters

42 41 4C 4F 47 48 20 37 35 30 31 38 20

ID code = «BALOGH 75018 »

7.5 POLLING PROTOCOL

This is a master/slave type protocol. Exchanges are initiated by the master and contain two messages: a request by the master and a response from the slave. All of the frames exchanged have the same basic structure:

1 byte	1 byte	n bytes	2 bytes
slave n°	function code	data	control

➔ The MRU reader is a slave on a MODBUS network
The master’s requests are addressed to a given slave reader (identified by its number in the frame's first field), or addressed to all of the slaves (distribution message).
Each message or frame contains 4 types of information:

- the address of the reader or the slave n° (1 byte):

  Specifies the destination reader, from 1 to 31. If the number is zero (00H), the message concerns all readers. In this case, there is no response.

- the function code (1 byte):

  Selects the type of command type (read, write, bit, word) and checks whether the response is correct.

- the data field (n bytes):

  Contains the parameters connected with the function: command code, values, number.

- the control word (2 bytes):

  Used to detect transmission errors (CRC16) – see previous paragraph

The MODBUS protocol defines up to 12 functions (the second field). Five of these are implemented in the MRU reader:

- function code 3 - read n words
- function code 5 - write one bit
- function code 6 - write one word
- function code 16 (0x10) - write n words
- function code 23 (0x17) - read/write n words

If the message received by the slave reader is incorrect (wrong CRC), the latter does not respond. If the message received is correct but the slave reader cannot process it (unknown function code or unknown command), it sends back an error message. This message has the same format as the other frames, but the MSB of the function code received is forced to 1 and the "data" field contains 1 byte with an error code.

Type of error	error code
Function code (2nd field) unknown	0x01
Command (3rd field) unknown	0x02
Incorrect data	0x03
System not ready	0x04
Write error (= execution error)	0x08
Air-link error, where n=error code n=1 → Tx channel not available (LBT) n=2 → no tag detected n=4 → tag memory read error n=8 →tag memory write error	0x8n

The inter-character wait time parameter allows the reader to synchronise itself with the start of a frame in the event that transmission is disrupted. The reader decides that there has been a break in the frame if the time separating the receipt of two characters exceeds the wait time between characters. The frame is then considered invalid.
The inter-character wait time for the MRU reader depends on the transmission speed and corresponds to 45 data bits which gives:

Bits/s	$T_{inter\text{-}character}$ (ms)
19200	2.3
9600	4.7
4800	9.4
1200	37.5

Below is a description of each type of command, in general, as specified by the MODBUS standard. See chapter 8 for a detailed description of each command.

7.5.1 WRITE ONE BIT (FUNCTION CODE 5)

- Request

		2 bytes	1 byte	1 byte	2 bytes
Reader address	05	command	value	00	CRC16

  - for bit = 0, value = 0x0
  - for bit = 1, value = 0xFF

- Response

		2 bytes	1 byte	1 byte	2 bytes
Reader address	05	command	value	00	CRC16

The “Response” frame is identical to the “Request” frame.
If the address is 0x0, all readers execute the command without transmitting a response.

7.5.2 WRITE ONE WORD (FUNCTION CODE 6)

- Request

		2 bytes	2 bytes	2 bytes
Reader address	06	command	value of word*	CRC16

** A word contains two characters, high-order followed by low-order*

- Response

		2 bytes	2 bytes	2 bytes
Reader address	06	command	value of word	CRC16

The “Response” frame is identical to the “Request” frame.
If the address is 0x0, all readers execute the command without transmitting a response.

7.5.3 WRITE N WORDS (FUNCTION CODE 16)

- Request

		2 bytes	2 bytes	1 byte	n bytes	2 bytes
Reader address	0x10	command	nb of words	nb of chars	values*	CRC16

** consecutive values of the words to be written, from the first to the last*
A word contains two bytes, high-order followed by low-order

- Response

		2 bytes	2 bytes	2 bytes
Reader address	0x10	command	nb of words	CRC16

If the address is 00H, all readers execute the command without transmitting a response.

7.5.4 READ N WORDS

- Request

		2 bytes	2 bytes	
Reader address	03	command	nb of words	CRC16

- Response

		1 byte	n bytes	
Reader address	03	nb chars read†	values*	CRC16

** consecutive values of the words to be written, from the first to the last*
† the number of chars read = 2 X the number of words in the request (always even)

7.5.5 READ/WRITE N WORDS (CODE FONCTION 23)

- Request

		2 bytes	2 bytes	2 bytes	2 bytes	1 byte	n bytes	2 bytes
Reader address	0x17	cmd	nb of words to read	Address to read	nb of words to write	nb of chars	values*	CRC16

- Response

		1 byte	n bytes	
Reader address	17	nb chars read†	values*	CRC16

** consecutive values of the words read/to be written, from the first to the last*
† the number of chars read = 2 X the number of words in the request (always even)

8 MODBUS COMMANDS

8.1 TABLE OF ALL COMMANDS

N°	Commands	Code function	Code command	Input parameter	Output parameter
1	Read status	0x03	0x0040	nb of words = 2	2 words **status** and **len_ config**
2	Read tag	0x03	0x0042	nb of words = n	n words **tag**
3	Read multi-tag	0x03	0x0094	nb of words = 8	8 words **status_mem**
4	Reset reader	0x05	0x0045	1 word **reset**	-
5	Persistence time	0x06	0x0046	1 word **time**	-
6	Indicator Light	0x06	0x0047	1 word **led**	-
7	Read previous tag	0x03	0x0048	nb of words = n	n words
8	Read firmware version	0x03	0x0049	nb of words = 1	1 word **version**
9	Read Configuration	0x03	0x004A	nb of words = 17	14 words **config**
10	Write Configuration	0x10	0x004B	17 words **config**	-
11	Read INIT errors	0x03	0x004F	nb of words = 1	1 word **status_e**
12	Write output	0x06	0x0052	1 word **output**	-
13	Read input	0x03	0x0053	nb of words = 1	1 word **output**
14	Read status mem_tags	0x03	0x0054	nb of words = 8	8 words **status_mem**
15	Read mem_tags	0x03	0x008x	nb of words = n	n words **tag**
16	Read reader type	0x03	0x0055	nb of words = 1	1 word **reader**
17	Read serial number	0x03	0x0070	nb words = 4	4 words **sn**
18	Write tag memory	0x10	0x005D	nb words = 9+n	-
19	Read tag memory	0x17	0x005E	nb words = 9	n words **tag memory**
20	Write EPC memory	0x10	0x0090	nb words = 9+n	-
21	Read EPC memory	0x17	0x0091	nb words = 9	n words **EPC memory**

8.2 DESCRIPTION OF THE COMMANDS

8.2.1 READ STATUS

This command reads 2 words:
The first word contains the reader status:

D15							D8	D7							D0
BA	0	N5	N4	N3	N2	N1	N0	0	E1	OV	CF	0	0	EE	BP

bit	name	Description
D15	BA	0 = 1 tag has been read, 1 = several tags have been read
D13-D8	N5 .. N0	Nb of characters in next tag ID code (in bytes) size of ID + 1 byte for antenna code (0x30)
D7	0	
D6	E1	State of input
D5	OV	Tag memory overflow (active 0)
D4	CF	Critical hardware fault (active 0)
D3	0	
D2	0	
D1	EE	State EEPROM (1 = OK, 0 = error)
D0	BP	1 = at least one tag is present in the antenna field (valid only in automatic-detection mode)

The second word consists of two bytes, the first is a constant 0x01 (1st byte) and the second is the length of the settings (config) in bytes: 0x22=34 (2nd byte).

Example: No tag present or waiting, eeprom OK, E1= "1" → input disabled

PC —> reader 01 03 00 40 00 02 C5 DF

reader —> PC 01 03 04 00 72 01 22 DB A1

8.2.2 SINGLE-TAG READ

Read of tag ID code, generally 12 bytes in EPC gen2. In order to read 13 bytes (1 for the antenna +12 pour the ID), the read command must read 7 words i.e. 14 bytes. If the number of words requested is different from the number of words actually present (this value is calculated from the value returned by the command "read status"), the reader responds with MODBUS error message n°8 (execution error). If the reader receives this command and there are no tags present, it also responds with error message 0x82 (air-link error, no tag detected) - see §7.5.

The structure of the fourth field (values) in the response frame is as follows:

1 byte	12 bytes	1 byte
antenna	ID	Filler (0x00)

Example: reading an ID of 12 bytes (01 02 03 04 05 06 07 08 09 0A 0B 0C)

PC —> reader 01 03 00 42 00 07 A4 1C

reader —> PC 01 03 0E 31 01 02 03 04 05 06 07 08 09 0A 0B 0C 00 09 DA

8.2.3 MULTI-TAG READ

The tag ID codes read by this command are stored in reader memory. This command does not return the ID codes of the detected tags, but returns, for each memory location, a one-byte-status which is 0 if there is no tag or n (different to 0) for a tag present of n bytes in length (same definition of length as for command N°15 "read status tag memory" see §8.2.14).

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
n1	n2	n3	n4	n5	N6	n7	n8	n9	n10	n11	n12	n13	n14	n15	n16

The command "Read mem_tags" must be used to read the ID codes present in reader memory.

Example: 4 tags present in memory locations n°1,2,5 and 7, each of 13 bytes (0x0D)

1) Detection of the 4 tags:

PC —> reader : 01 03 00 94 00 08 05 E0

reader —> PC : 01 03 10 0D 0D 00 00 0D 00 0D 00 00 00 00 00 00 00 00 00 20 CC

2) Reading the IDs of the 4 tags:

PC —> reader : 01 03 00 80 00 07 05 E0 (read memory n°1)

reader —> PC : 01 03 0E 31 30 30 30 12 23 34 45 56 67 78 89 07 00 E8 9D

PC —> reader : 01 03 00 81 00 07 54 20 (read memory n°2)

reader —> PC : 01 03 0E 31 30 30 30 12 23 34 45 56 67 78 89 08 00 ED 6D

PC —> reader : 01 03 00 84 00 07 44 21 (read memory n°5)

reader —> PC : 01 03 0E 31 30 30 30 12 23 34 45 56 67 78 89 02 00 EB CD

PC —> reader : 01 03 00 86 00 07 E5 E1 (read memory n°7)

reader —> PC : 01 03 0E 31 30 30 30 12 23 34 45 56 67 78 89 10 00 E7 6D

Antenna = 0x31 = "1"

ID = 12 bytes

Filler = 0x00

CRC16

Care must be taken to read the tag - after detection - in a time less than that given by the parameter "Persistence" (see § 5.3.2)

8.2.4 RESET READER

If the value of the byte to send is 0, a reader reset occurs. Any other value triggers an error message n°3 (incorrect data).

Example: Reset the reader

PC —> reader 01 05 00 45 00 00 DC 1F
reader —> PC 01 05 00 45 00 00 DC 1F

8.2.5 PERSISTENCE TIME

The time-out value in multiples of 50 ms is shown in the table below:

parameter	Multiples of 50ms	Persistence time (s)
0	2	0.1
1	10	0.5
2	20	1
3	40	2
4	100	5
5	200	10

A value of 0 corresponds to a very short persistence time and could lead to multiple detection messages - to be used with caution.

Example: Setting up a persistence time of 2s

PC —> reader 01 06 00 46 00 03 28 1E
reader —> PC 01 06 00 46 00 03 28 1E

8.2.6 INDICATOR LIGHT

In order for this command to work, the indicator light setting must be have previously been put into the "host" position with a MODBUS command.
Two bytes must be sent, the high-order byte first, followed by the low-order byte.

D15							D8	D7							D0
0	RV	CF	AE	T3	T2	T1	T0	x	x	x	x	x	x	x	x

RV : 0 = LED is red, 1 = LED is green

CF : 0 = flashing, 1 = fixed

AE : 0 = turn on, 1 = turn off

T3 .. T0 : On / Off time for flashing, in multiples of 50ms

4-bit binary coding (from 50 ms / 50 ms à 750 ms / 750 ms) for example,

0001 : flashing 50ms / 50 ms
0010 : flashing 100ms / 100 ms
0011 : flashing 150ms / 150 ms
.....
1111 : flashing 750ms / 750 ms

Example: Setting up for red flashing of 250/250ms

PC —> reader 01 06 00 47 05 00 3A 8F
reader —> PC 01 06 00 47 05 00 3A 8F

8.2.7 READ PREVIOUS TAG ID CODE

This command only works in automatic detection mode, it allows retransmission of the previous tag ID code providing that the previous message sent was the reply to a read tag command, in other words that no other transmission has occurred since. It is used in polling mode if the reader's reply to the "read tag" command contains errors (CRC error). This command is useful mainly because tag ID code messages (both for appearance and disappearance) are only sent once. The number of words to be read must be identical to that indicated in the preceding command, if not there is no re-transmission.

Example: Read Tag command where the reply contains an error, followed by an error-free reply

PC —> reader 01 03 00 42 00 07 A4 C (read 7 words)

reader —> PC 01 03 0E 30 01 02 03 04 05 06 07 08 09 0A 0B 0C 00 09 1B (CRC error)

PC —> reader 01 03 00 48 00 07 81 1E (read 7 words again)

reader —> PC 01 03 0E 30 01 02 03 04 05 06 07 08 09 0A 0B 0C 00 09 1B (CRC OK)

If another type of command was transmitted after the incorrect response but before the re-transmission request, the re-transmission would not have been possible.

8.2.8 READ FIRMWARE VERSION

If the command parameter nb of words is not equal to 1, the reader replies with the MODBUS error 3 (Incorrect data). The reader returns a word **version** (2 bytes, high-order first).

D15 D12	D11 D8	D7 D4	D3 D0
type	major index	minor index	minor index

The type identifies the reader family. For the MRU reader this value is 1.
Index identify the firmware version.
The 4 fields contain BCD-coded numbers.
Example: MRU with firmware version 0.4.5 (Code BCD = 1045H)

PC —> reader 01 03 00 49 00 01 55 DC

reader —> PC 01 03 02 10 45 74 77 (MRU v0.4.5)

8.2.9 READ SETTINGS

Reads 34 bytes, which give, in order, the value of each of the reader's parameters, starting with parameter 1 (see §5.2).
Example: read 17 words = 34 bytes

PC —> reader 01 03 00 4A 00 11 A4 10

reader —> PC 01 03 22 00 01 02 01 01 00 00 00 03 00 00 00 01 00 00 00 00 02 00 01 00 13 00 00 00 04 00 00 01 01 01 00 00 00 C4 99

8.2.10 WRITE SETTINGS

Writes 34 bytes which will determine, in order, the value of each of the reader's parameters, starting with parameter 1 (see §5.2), . It is possible to write less than 34 bytes, but the sequence always starts with the byte for parameter n°1.
Example: write 17 words = 34 bytes

PC —> reader 01 10 00 4B 00 11 22 00 01 02 01 01 00 00 00 03 00 00 00 01 00 00 00 00 02 00 01 00 13 00 00 00 04 00 00 01 01 01 00 00 00 BF F4

reader —> PC 01 10 00 4B 00 11 70 13

8.2.11 READ INIT ERRORS

During the initialisation phase (after a processor reset), a certain number of components are tested. The result of each test is memorised (0=OK, 1=fault). This command will read the result of these tests provided of course that the fault is not so serious as to prevent correct operation of the processor and the serial link. The command must read one word, of which the first (high-order) byte is significant:

Structure of the error code byte:

Bit	Description	Consequence
1		
2		
3	EEPROM error	Degraded operation
4		
5	Serial number	Degraded operation
6	Serial link error	Degraded operation
7		
8	Air-link error	Critical – reader out of order

Example: No error

PC —> reader 01 03 00 4F 00 01 B5 DD

Reader —> PC 01 03 02 00 00 B8 44

8.2.12 WRITE DIGITAL OUTPUT

Allows writing the state of the digital output S. The first byte is not significant, the second determines the state.

D15								D8	D7						D0
x	x	x	x	x	x	x	x	0	0	0	x	x	x	x	S

S : 0 = deactivate the output, 1 = activate the output

Example: activate output

PC —> reader 01 06 00 52 01 01 E8 4B

reader —> PC 01 06 00 52 01 01 E8 4B

Note: in order to be able to write to the output, the corresponding parameter must be in the “host” position (see §5.3.14).

8.2.13 READ INPUT

Performs an immediate read of the state of the digital input. The response contains two bytes:

D15								D8	D7					D1	D0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	E

E : 0 = input activated, 1 = input deactivated

Example: read the digital input (deactivated)

PC —> reader 01 03 00 53 00 01 74 1B

reader —> PC 01 03 02 00 01 79 84

8.2.14 READ TAG MEMORY STATUS

This command only works in automatic detection mode and in manual mode with command “Read multi-tag”. Allows knowing if tags are present in the reader's memory. A tag is present from the time it appears to the time it disappears. It occupies one of the 16 memory possible locations. This command returns, for each memory location, a one-byte-status which is 0 if there is no tag or n (other than 0) for a tag present of n bytes in length (same definition of length as for command N°1 "read status").

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
n1	n2	n3	n4	n5	n6	n7	n8	n9	n10	n11	n12	n13	n14	n15	n16

Example : 1 tag of 13 bytes present

PC —> reader : 01 03 00 54 00 08 05 DC

reader —> PC : 01 03 10 0D 00 00 00 00 00 00 00 00 00 00 00 00 00 00 20 CC

8.2.15 READ TAG IN MEMORY

Reads a tag code in the internal memory. The length to be read is given by two commands: "read tag memory status" and “Read multi-tag”. If in the meantime the tag has disappeared, the reader responds with a MODBUS error frame n°8 “execution error". To read a tag in location 1, the command code 80H is used, for location 2 it's 81H and so on up to location 16, which is 8FH.
Example: read 7 words = 14 bytes of tag present at location 0x00

PC —> reader 01 03 00 80 00 07 05 E0

reader —> PC 01 03 0E 30 01 02 03 04 05 06 07 08 09 0A 0B 0C 00 09 1B

8.2.16 GET READER TYPE

Allows determining the reader hardware version (reads 1 word). The first byte returns the version.

1	2
type	00

type:

type	Reader
0	MRU
1	not used
2	not used
3	not used

Example:

PC —> reader 01 03 00 55 00 01 94 1A
reader —> PC 01 03 02 00 00 B8 44

8.2.17 GET SERIAL NUMBER

Returns the reader’s electronic serial number. Four words are returned in the following order (8 bytes = 64 bits):

1 byte	1 byte	1 byte	1 byte	1 byte	1 byte	1 byte	1 byte
sn[7]	sn[6]	sn[5]	sn[4]	sn[3]	sn[2]	sn[1]	sn[0]

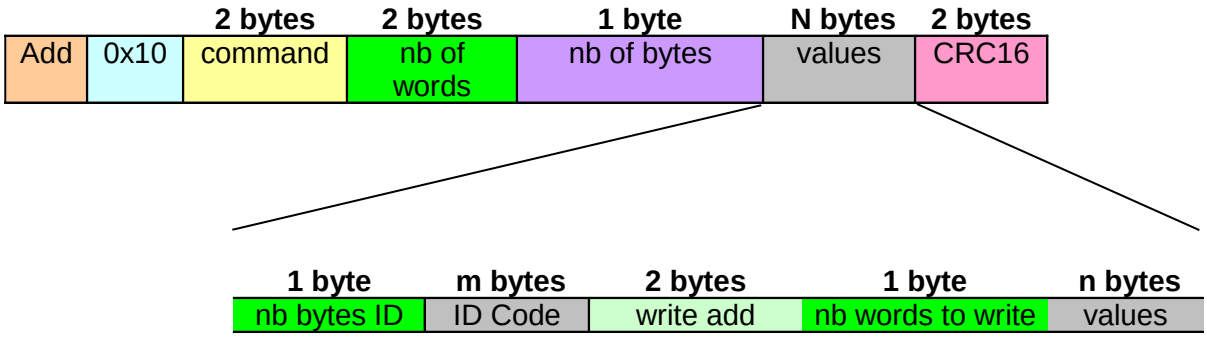
Example: Get serial number: 0x01A0A02B14000062

PC —> reader 01 03 00 70 00 04 45 D2
reader —> PC 01 03 08 01 A0 A0 2B 14 00 00 62 46 AE

8.2.18 WRITE TAG MEMORY

Allows writing data into the tag memory. The tag memory contains words organised as 16 bits. This command has no knowledge of any internal tag memory structure, it only allows writing N words to a specific address.
A maximum of 128 bytes can be written with this command.

Looking at the frame structure of the MODBUS function code 0x17:



The "values" field is divided up into 5 sub-fields which define the data to be written.

Reminder:
The memory of a UHF EPC C1G2 tag is generally organised as 4 banks:
Bank "00" Reserved
Bank "01" EPC : This memory zone contains the tag's ID code, take great precautions before modifying this.
Bank "10" Tag Id: This zone is optional, it generally contains a code from the chip manufacturer and a model number for the chip. This is a read-only zone.
Bank "11" User memory: This zone, when it exists, is available for the user for both reading and writing.

Example: write 1 word (0x0102) to address 0x0310 (0x03 = "11" = user bank for an EPC tag and 0x10 = physical address in that bank) to the tag 0xE2009040530102400550DC0B:

PC —> reader 01 10 00 5D 00 09 12 0C E2 00 90 40 53 01 02 40 05 50 DC 0B 03 10 01 01 02 BB 52
reader —> PC 01 10 00 5D 00 09 91 DD

The words must be written high-order byte first, thus 0x0102 = 0x01 0x02.

8.2.19 READ TAG MEMORY

Allows reading data from the tag memory. The tag memory contains words organised as 16 bits. This command has no knowledge of any internal tag memory structure, it only allows reading N words from a specific address.
A maximum of 128 bytes can be read with this command.

Looking at the frame structure of the MODBUS function code 0x17:

		2 bytes	2 bytes	2 bytes	2 bytes	1 byte	N bytes	2 bytes
Add	0x17	command	nb words	read add	nb words ID	nb bytes ID	ID Code	CRC16

The 3 fields preceding the CRC define the tag for the read.

Reminder:
The memory of a UHF EPC C1G2 tag is generally organised as 4 banks:
Bank "00" Reserved
Bank "01" EPC : This memory zone contains the tag's ID code, take great precautions before modifying this.
Bank "10" Tag Id: This zone is optional, it generally contains a code from the chip manufacturer and a model number for the chip. This is a read-only zone.
Bank "11" User memory: This zone, when it exists, is available for the user for both reading and writing.

Example: read 5 words from address 0x0310: (0x03 = "11" = user bank for an EPC tag and 0x10 = physical address in that bank) to the tag 0xE2009040530102400550DC0B:

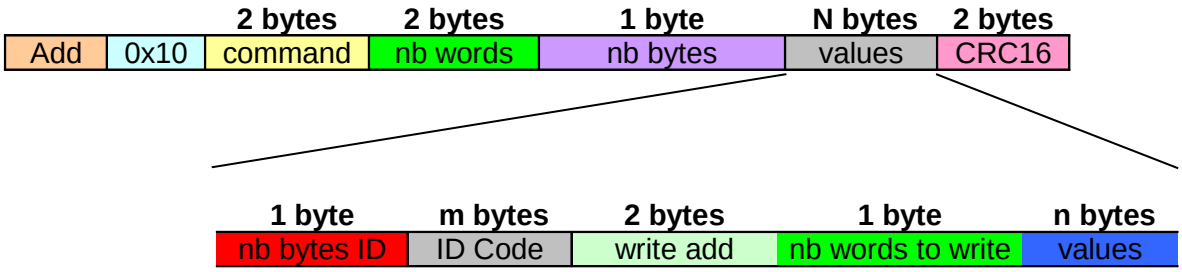
PC —> reader 01 17 00 5E 00 05 03 10 00 06 0C E2 00 90 40 53 01 02 40 05 50 DC 0B FF 5D
reader —> PC 01 17 0A 01 02 03 04 05 06 07 08 09 10 56 89

The words must be written high-order byte first, **thus 0x0102** = 0x01 0x02.

8.2.20 **WRITE EPC MEMORY**

This command "WRITE_TAG_MEMORY_EPC" (0x0090) is similar to the existing command WRITE_TAG_MEMORY (0x005D).

Looking at the frame structure of the MODBUS function code 0x17:



The "values" field is further divided up into 5 sub-fields which define the data to be written.

Example: write 1 word (0x0102) to address 0x0104 (0x01 = "01" = EPC bank and 0x04 = physical address in that bank) to the tag 0xE2009040530102400550DC0B:

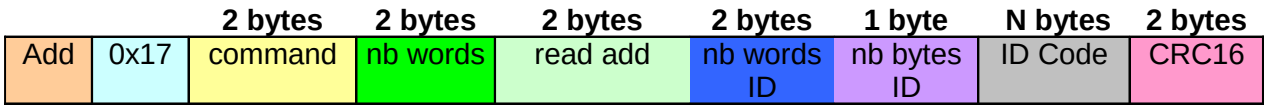
PC —> reader 01 10 00 90 00 09 12 0C E2 00 90 40 53 01 02 40 05 50 DC 0B 01 04 01 01 02 17 A7
reader —> PC 01 10 00 90 00 09 00 22

The words must be written high-order byte first, **thus 0x0102** = 0x01 0x02.

8.2.21 **READ EPC MEMORY**

This command "READ_TAG_MEMORY_EPC" (0x0091) is similar to the existing command READ_TAG_MEMORY (0x005E).

Looking at the frame structure of the MODBUS function code 0x17:



The 3 fields preceding the CRC define the tag for the read.

Example: read 5 words at address 0x0104 (0x01 = "01" = EPC bank and 0x04 = physical address in the bank) from tag 0xE2009040530102400550DC0B:

PC —> reader 01 17 00 91 00 05 01 04 00 06 0C E2 00 90 40 53 01 02 40 05 50 DC 0B 14 DD
reader —> PC 01 17 0A E2 00 90 40 53 01 02 40 05 50 CB 11

The words must be written high-order byte first, thus 0x0104 = 0x01 0x04.

9 USB INTERFACE

> The reader model MRUxxxx ETH has three serial data interfaces: USB, ETHERNET, RS. These three cannot operate simultaneously, only one at a time can be used. Selection is done automatically when cables are connected, according to the following priority:
>
> **USB > ETHERNET > RS**
>
> In order to use the RS interface it is necessary to disconnect any cables on the ethernet and USB connectors.
>
> The USB interface has priority over the other interfaces, so the USB cable must be removed in order to use the ethernet or RS interfaces.

This interface allows connecting the reader to a PC. It has the following characteristics:
- B-type connector on host side
- compatible with USB 2.0
- compatible with controllers UHCI/EHCI/OHCI

This interface requires no setting up.

To use this interface to communicate with the reader from a PC, the appropriate driver must be installed:

➢ **Virtual COM port**: This method installs an extra COM port (COM5 or other) and allows operation with existing applications that use COM ports(Hyperterminal…).

The setup procedure for Windows XP is described below

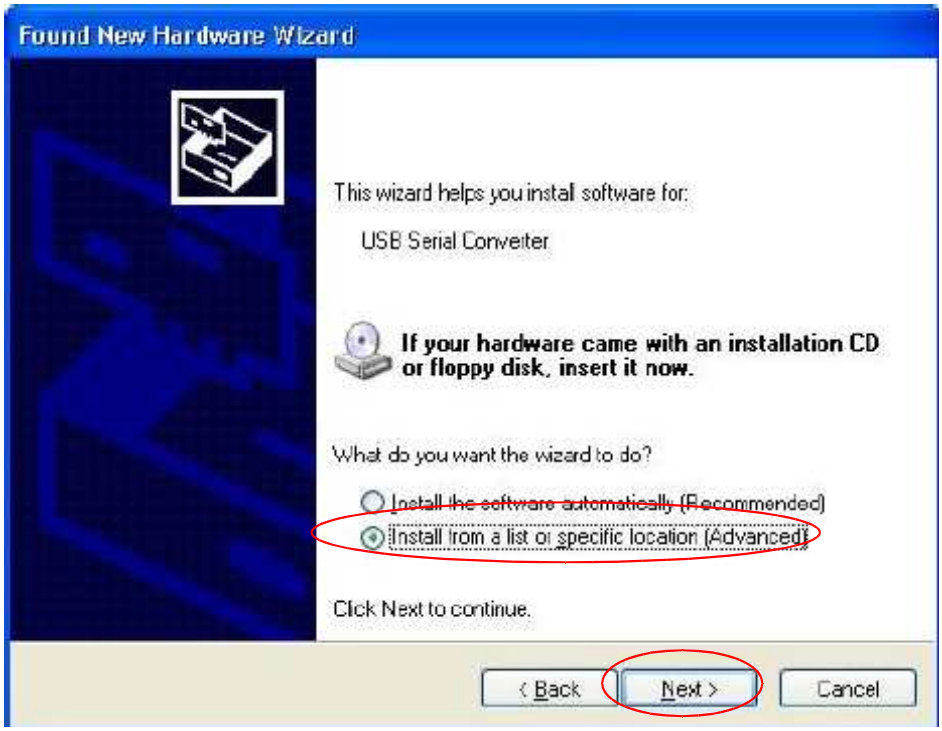
Step 1: Download the software "VCP driver" from the FTDI website (http://www.ftdichip.com/Drivers/VCP.htm) and unzip into a folder to be used in step 5.

Step 2: Connect the MRU reader to a USB port, follow the prompts to install the FTDI driver and, if necessary, use the installation guide (OS-dependent) available on the FTDI website,.

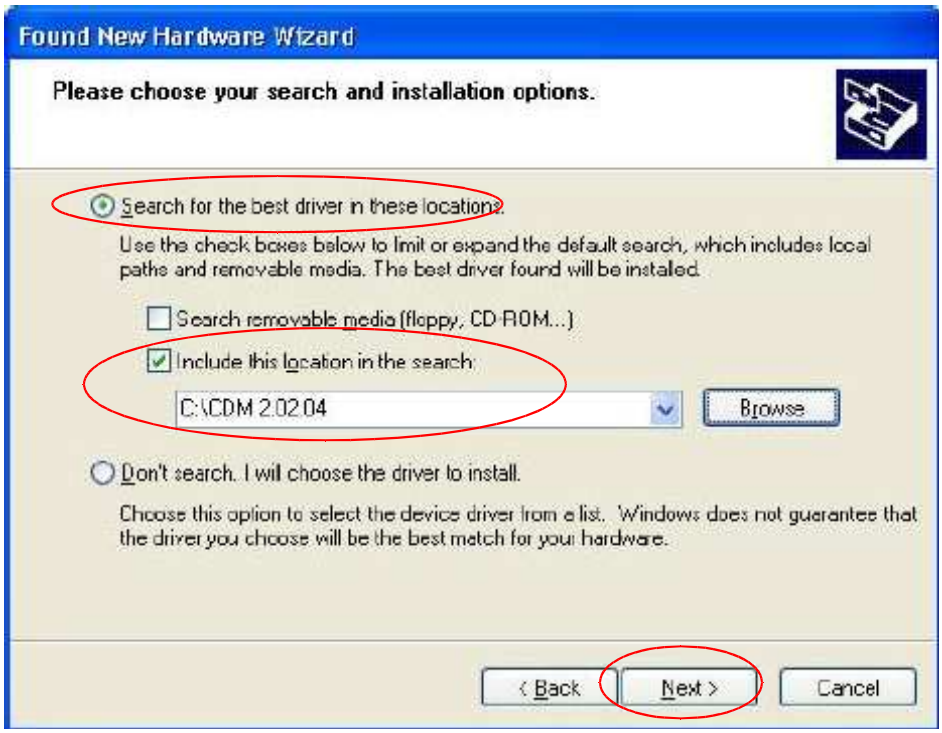
Step 3: Windows XP detects the USB connection and displays the following dialog box: select "No, not this time" then click on "Next"

Found New Hardware Wizard
Welcome to the Found New Hardware Wizard
Windows will search for current and updated software by looking on your computer, on the hardware installation CD, or on the Windows Update Web site (with your permission).
Online privacy information
Can Windows connect to Windows Update to search for software?
Yes, this time only
Yes, now and every time I connect a device
No, not this time
Click Next to continue.
< Back
Next >
Cancel

Step 4: Select "Install from a list or specific location (Advanced)", then click on "Next".


Found New Hardware Wizard
This wizard helps you install software for:
USB Serial Converter
If your hardware came with an installation CD or floppy disk, insert it now.
What do you want the wizard to do?
Install the software automatically (Recommended)
Install from a list or specific location (Advanced)
Click Next to continue.
< Back
Next >
Cancel

Step 5: Select "Search for the best driver in these locations" and indicate the path to the folder where the driver was unzipped, (see step 1), then click on "Next".

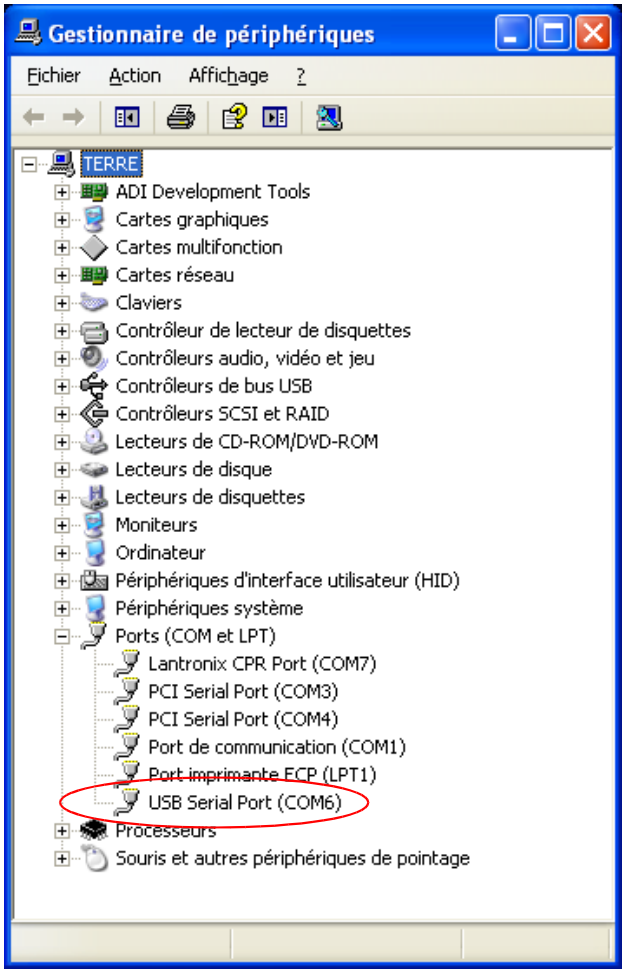

Found New Hardware Wizard
Please choose your search and installation options.
Search for the best driver in these locations.
Use the check boxes below to limit or expand the default search, which includes local paths and removable media. The best driver found will be installed.
Search removable media (floppy, CD-ROM...)
Include this location in the search:
C:\CDM 2.02.04
Browse
Don't search. I will choose the driver to install.
Choose this option to select the device driver from a list. Windows does not guarantee that the driver you choose will be the best match for your hardware.
< Back
Next >
Cancel

Step 6: Click on "Continue Anyway" to proceed with the installation.

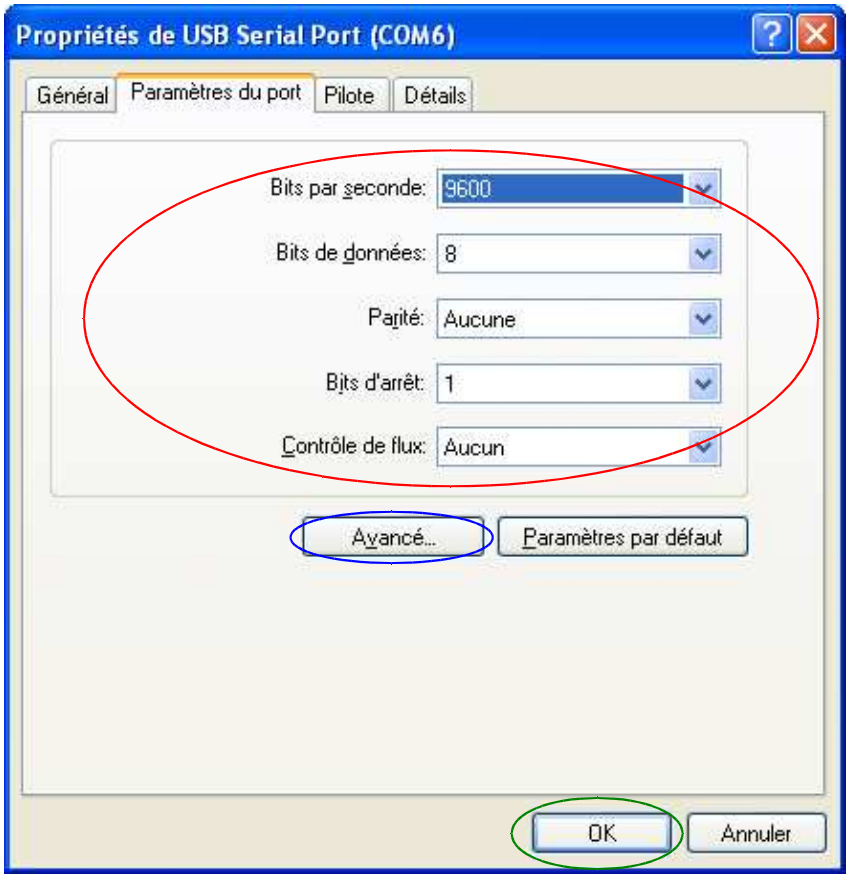
Hardware Installation
The software you are installing for this hardware:
USB Serial Converter
has not passed Windows Logo testing to verify its compatibility with this version of Windows. (Tell me why this testing is important.)
Continuing your installation of this software may impair or destabilize the correct operation of your system either immediately or in the future. Microsoft strongly recommends that you stop this installation now and contact the hardware vendor for software that has passed Windows Logo testing.
Continue Anyway
STOP Installation

Step 7: Click on "Finish" to end the installation.

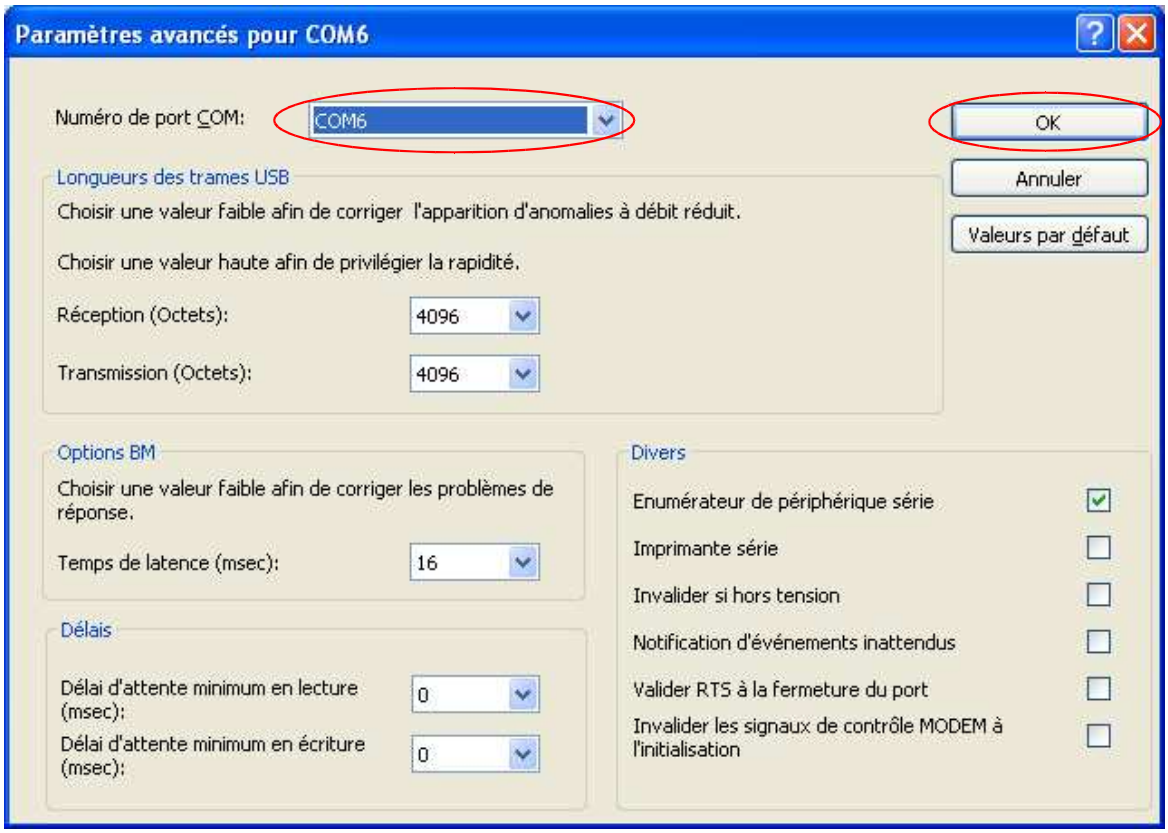
Step 8: check the association in the device manager.



Step 9: Check that the serial port settings match those of the user software (example: 9600bps, 8, 1, none): double click on "USB Serial Port (COM6)", tab "Port Parameters".



Step 10: If necessary, change the associated COM port number,by clicking on "Avanced" and select a new COM port number, then click on "OK" and again on "OK".


Paramètres avancés pour COM6
Numéro de port COM: COM6
OK
Annuler
Valeurs par défaut
Longueurs des trames USB
Choisir une valeur faible afin de corriger l'apparition d'anomalies à débit réduit.
Choisir une valeur haute afin de privilégier la rapidité.
Réception (Octets): 4096
Transmission (Octets): 4096
Options BM
Choisir une valeur faible afin de corriger les problèmes de réponse.
Temps de latence (msec): 16
Délais
Délai d'attente minimum en lecture (msec): 0
Délai d'attente minimum en écriture (msec): 0
Divers
Enumérateur de périphérique série
Imprimante série
Invalider si hors tension
Notification d'événements inattendus
Valider RTS à la fermeture du port
Invalider les signaux de contrôle MODEM à l'initialisation

Step 11: Close the device manager.

The reader can now be accessed via a virtual COM port (e.g. COM6) with the usual software.

➢ **DLL** : This method allows developers to write their own application software by using the function library provided by the D2XX driver which can be found on here: http://www.ftdichip.com/Drivers/D2XX.htm

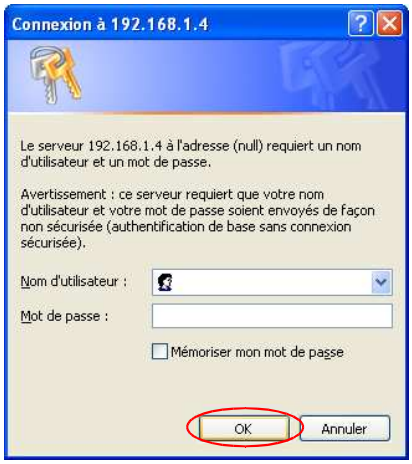
10 ETHERNET INTERFACE

> **This interface is only available with the MRUxxxx ETH reader model**
>
> The reader model MRU ETH has three serial data interfaces: USB, ETHERNET, RS.
> These three cannot operate simultaneously, only one at a time can be used. Selection is done automatically when cables are connected, according to the following priority:
>
> **USB > ETHERNET > RS**
>
> In order to use the ethernet interface it is necessary to disconnect the USB cable.
> The ethernet interface has priority over the RS interface, so the ethernet cable must be removed in order to use the RS interface

This interface allows connecting the reader to an ethernet network with a standard RJ45 connector at the host end.
It has the following characteristics:

- link protocols supported: ARP, UDP/IP, TCP, ICMP, SNMP, DHCP, BOOTP, TCP port 502 (MODBUS) open in transparent mode
- application-level protocols: MODBUS RTU

By default, the reader uses dynamic addressing, so normally no address setup is necessary on this interface. If necessary, the network parameters can be set up using a browser connected to the embedded web server. By default, no login or password for connecting to the embedded web server have been set up, simply click on OK.


Connexion à 192.168.1.4
Le serveur 192.168.1.4 à l'adresse (null) requiert un nom d'utilisateur et un mot de passe.
Avertissement : ce serveur requiert que votre nom d'utilisateur et votre mot de passe soient envoyés de façon non sécurisée (authentification de base sans connexion sécurisée).
Nom d'utilisateur :
Mot de passe :
Mémoriser mon mot de passe
OK
Annuler

For the current version,only the MODBUS RTU protocol is implemented. Therefore the application data transmitted over the TCP socket must be MODBUS RTU frames. The interface component performs neither conversion nor interpretation.

Communication with the reader over Ethernet is done using the virtual COM port just as for a serial interface.

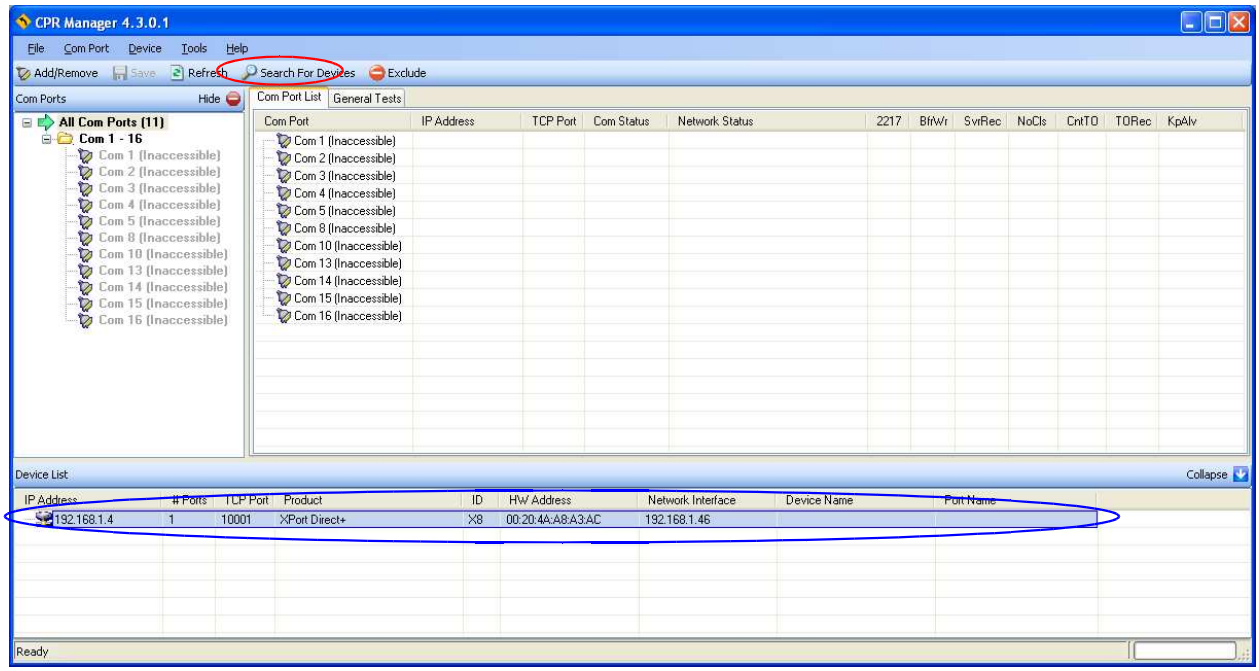
The setup procedure for Windows XP is described below:

Step 1: Download the software "CPR Manager" from the Lantronix website (http://www.lantronix.com/support/downloads/?p=CPR)

Step 2: Install and run the "CPR Manager" software using, if necessary, the "COM Port Redirector Quick Start Guide" available on the Lantronix website.

Step 3: Connect the MRU reader to an ethernet network

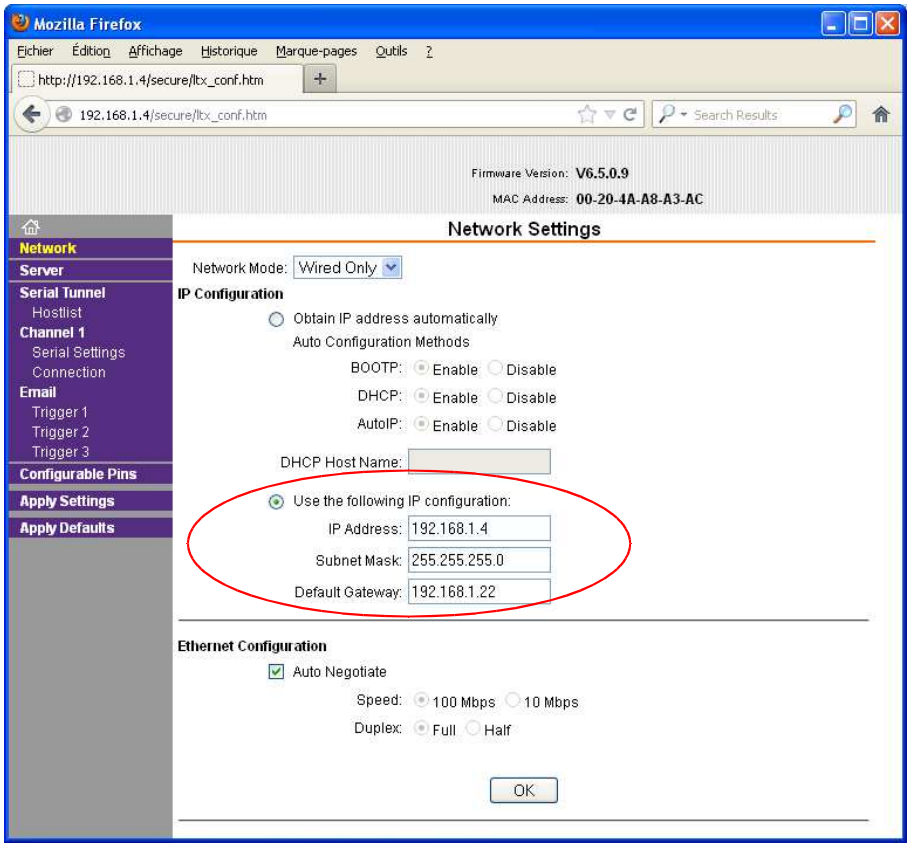
Step 4: Detect the reader using the "CPR Manager" → use button "Search for devices"



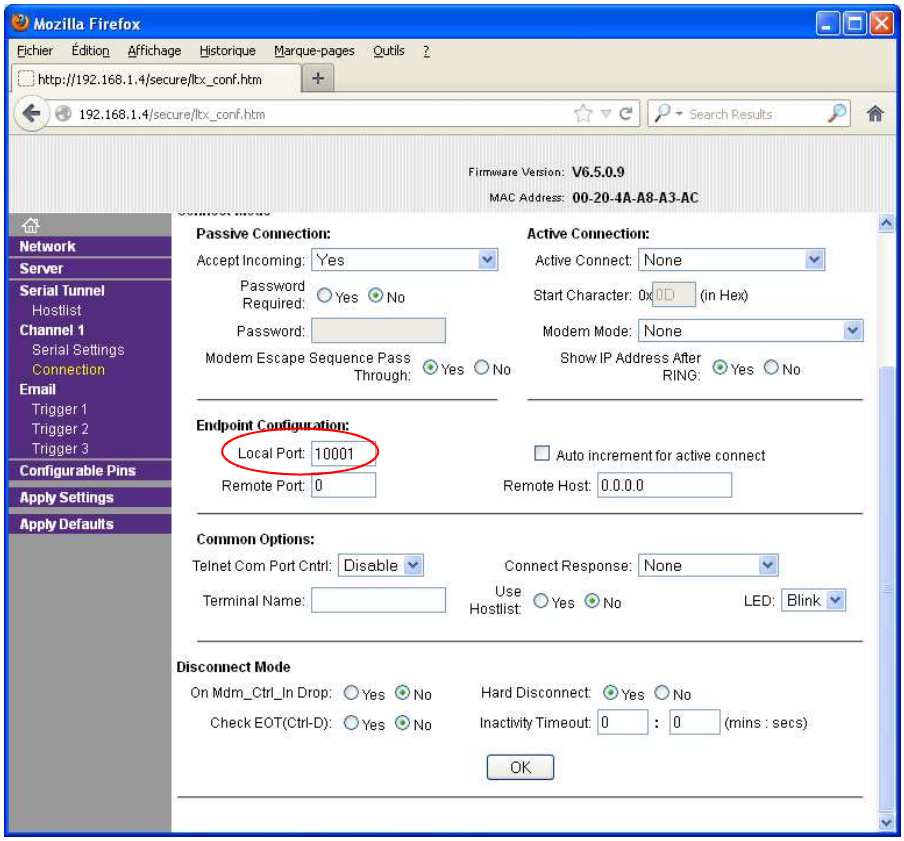
Step 5: Connect to embedded web server → right click on the corresponding IP address in the "device list" (e.g. 192.168.1.4) → select "Launch Web Interface to Device"

Step 6: Click on OK leaving the fields "User Name" and "Password" blank

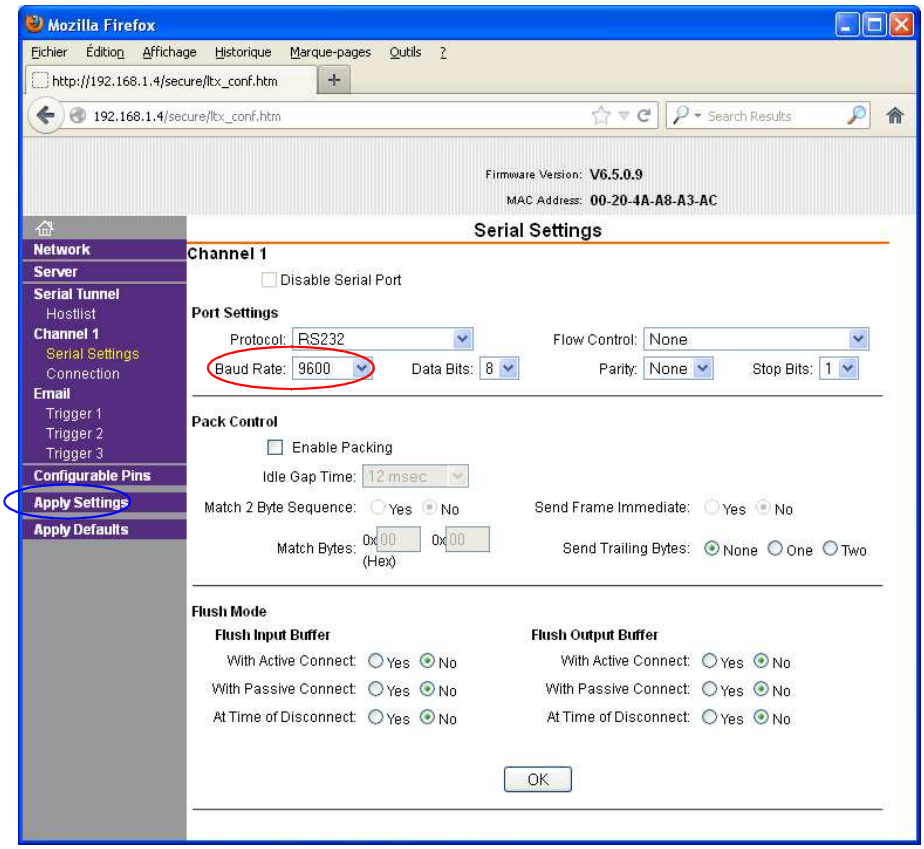
Step 7: On the "Network" tab set up a fixed IP address so that a COM port number can be associated with it (e.g. 192.168.1.4)



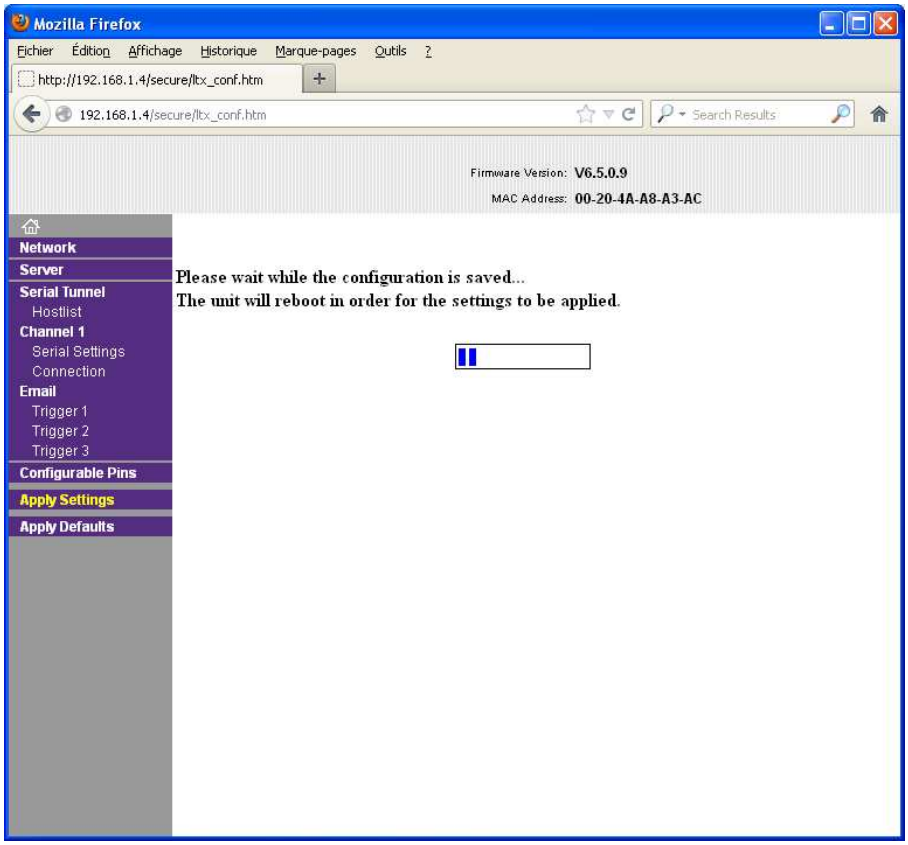
Step 8: On the "Channel1/Connection" tab, check the TCP port number(10001)



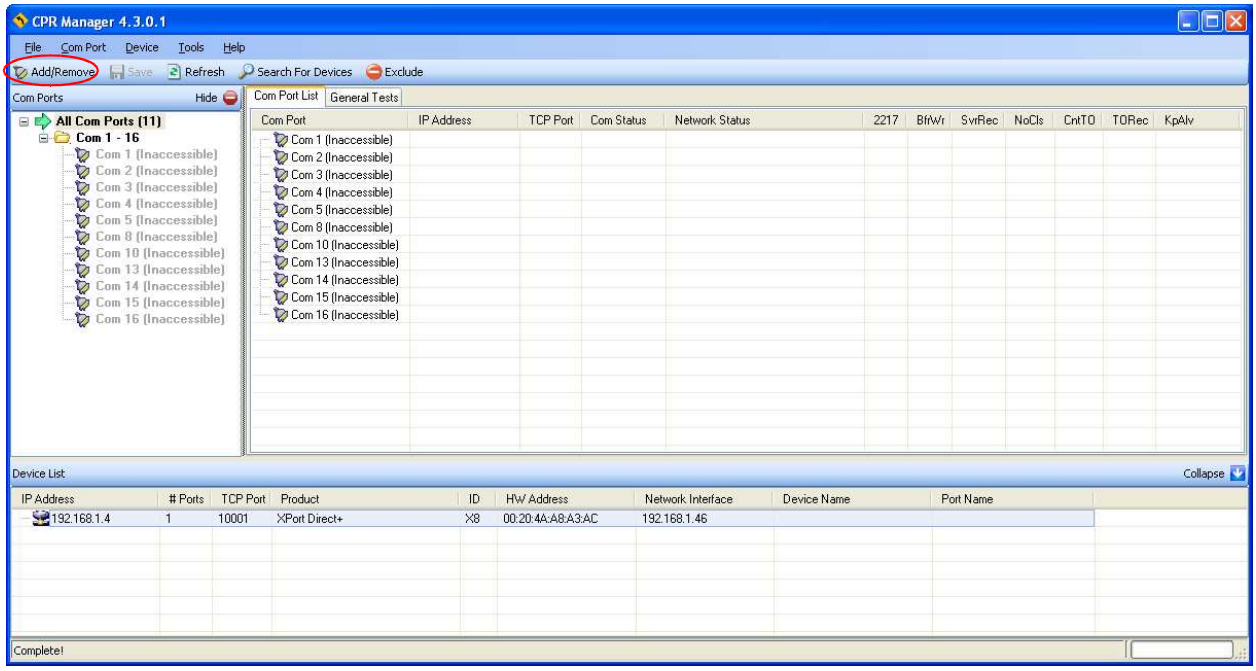
Step 9: On the "Channel1/Serial Settings" tab, check that the transmission speed matches that of the user software (e.g. 9600bps)



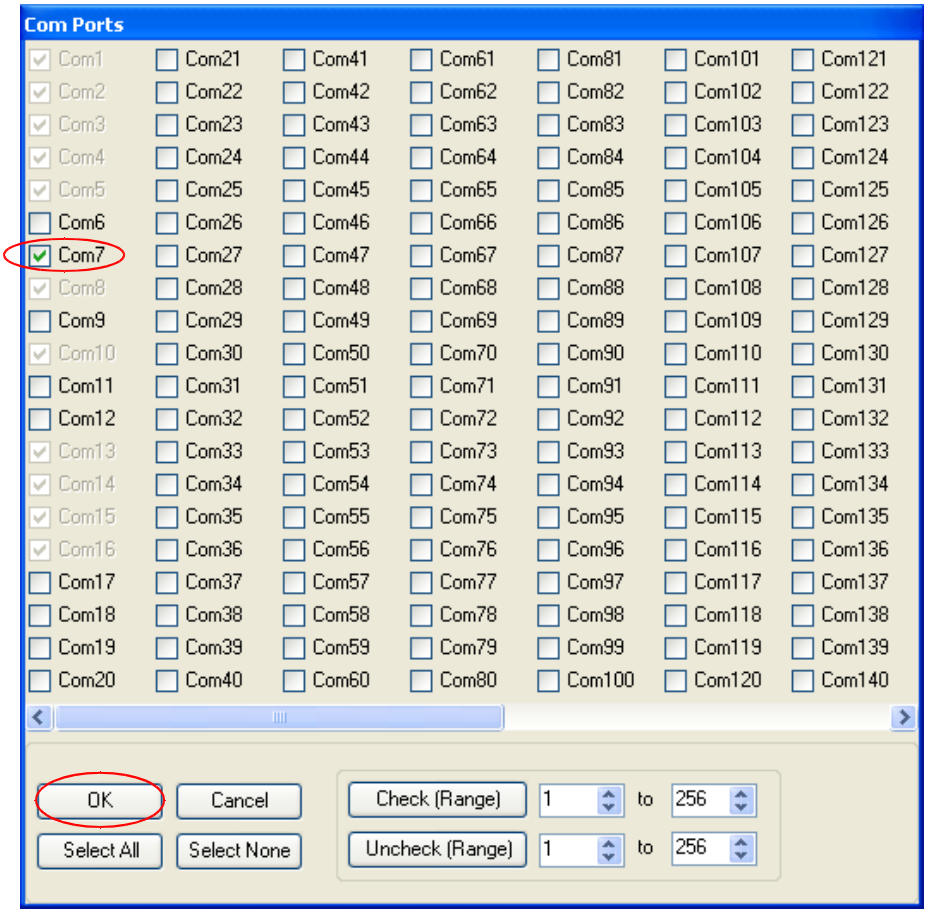
Step 10: Confirm the changes by clicking on "Apply Settings"



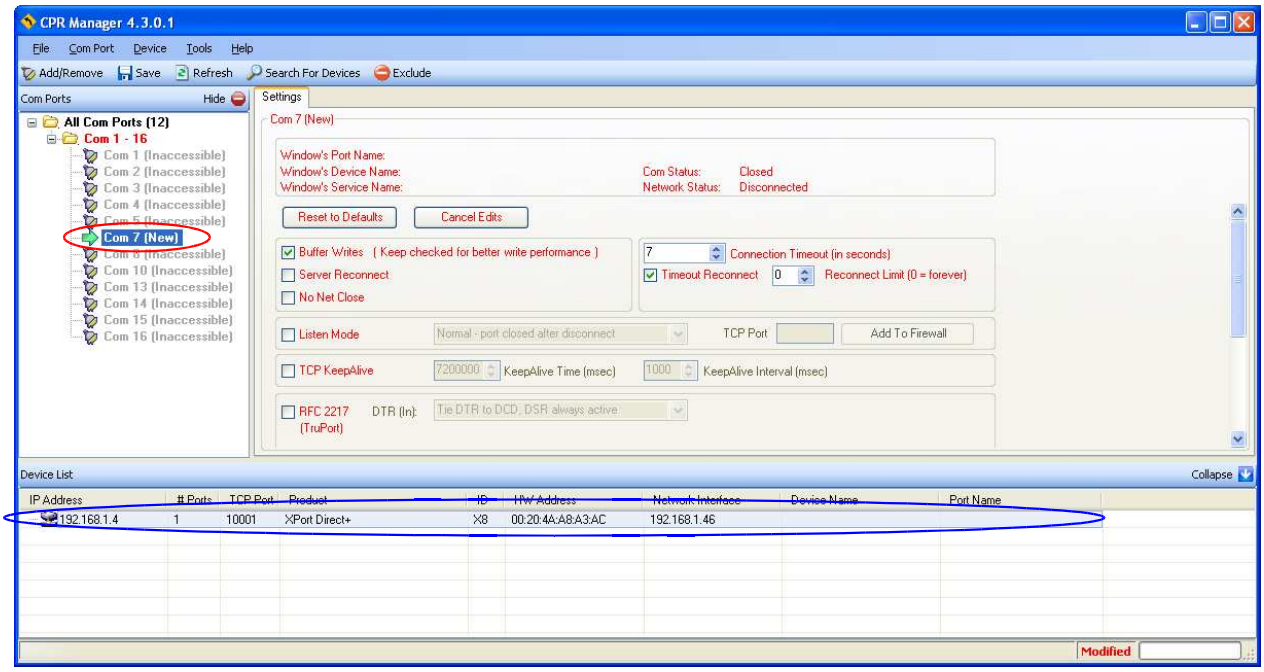
Step 11: Associate the IP address with a COM port number with the "CPR Manager" ‣ Add/remove



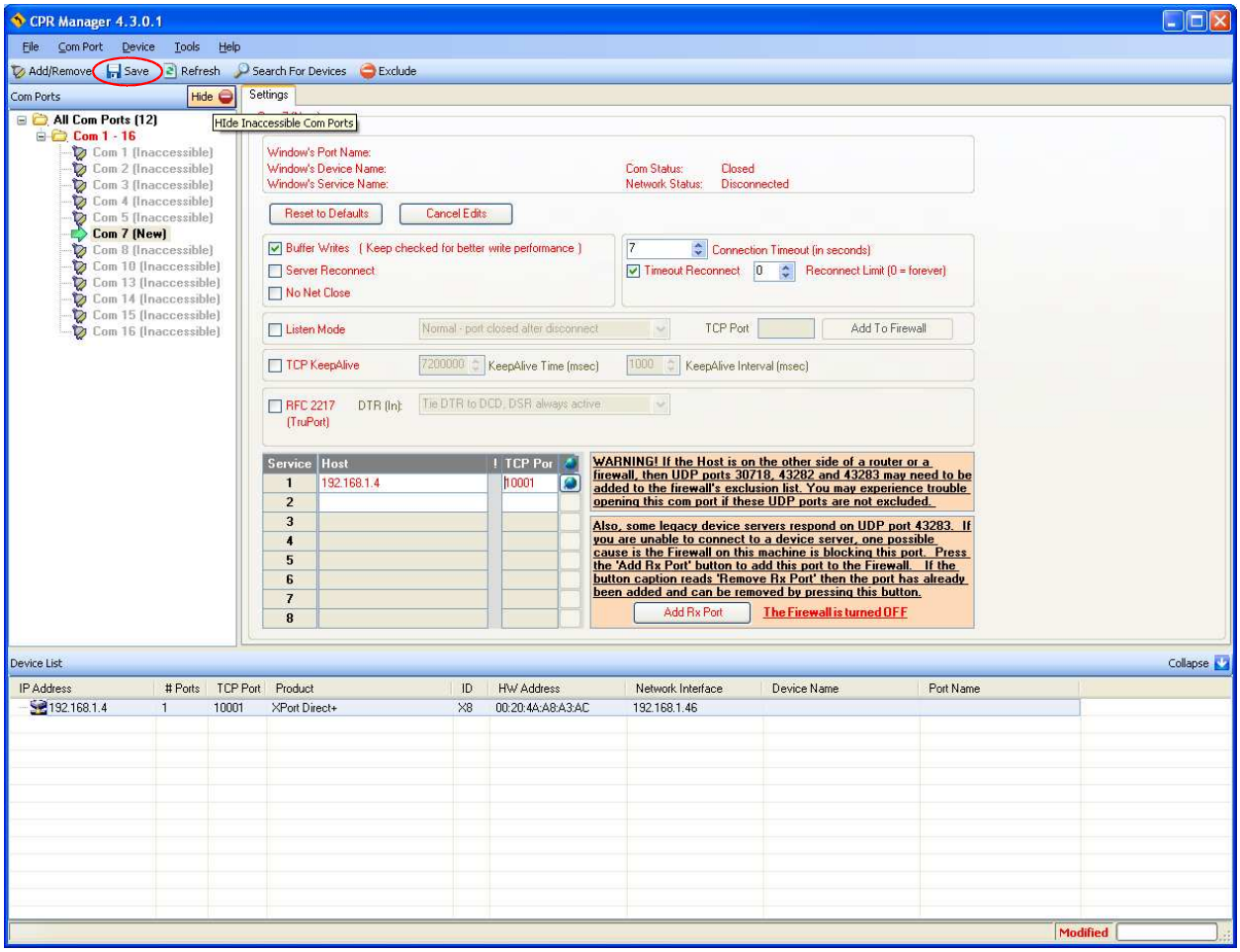
Select a COM port (e.g. COM7), then click on OK


Com Ports
Com1 Com21 Com41 Com61 Com81 Com101 Com121
Com2 Com22 Com42 Com62 Com82 Com102 Com122
Com3 Com23 Com43 Com63 Com83 Com103 Com123
Com4 Com24 Com44 Com64 Com84 Com104 Com124
Com5 Com25 Com45 Com65 Com85 Com105 Com125
Com6 Com26 Com46 Com66 Com86 Com106 Com126
Com7 Com27 Com47 Com67 Com87 Com107 Com127
Com8 Com28 Com48 Com68 Com88 Com108 Com128
Com9 Com29 Com49 Com69 Com89 Com109 Com129
Com10 Com30 Com50 Com70 Com90 Com110 Com130
Com11 Com31 Com51 Com71 Com91 Com111 Com131
Com12 Com32 Com52 Com72 Com92 Com112 Com132
Com13 Com33 Com53 Com73 Com93 Com113 Com133
Com14 Com34 Com54 Com74 Com94 Com114 Com134
Com15 Com35 Com55 Com75 Com95 Com115 Com135
Com16 Com36 Com56 Com76 Com96 Com116 Com136
Com17 Com37 Com57 Com77 Com97 Com117 Com137
Com18 Com38 Com58 Com78 Com98 Com118 Com138
Com19 Com39 Com59 Com79 Com99 Com119 Com139
Com20 Com40 Com60 Com80 Com100 Com120 Com140
OK
Cancel
Select All
Select None
Check (Range) 1 to 256
Uncheck (Range) 1 to 256

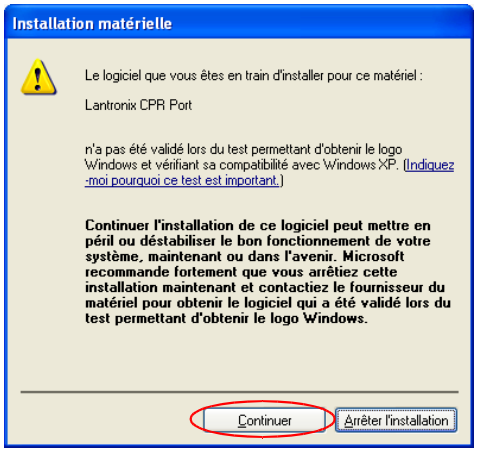
Step 12: Select the new COM port



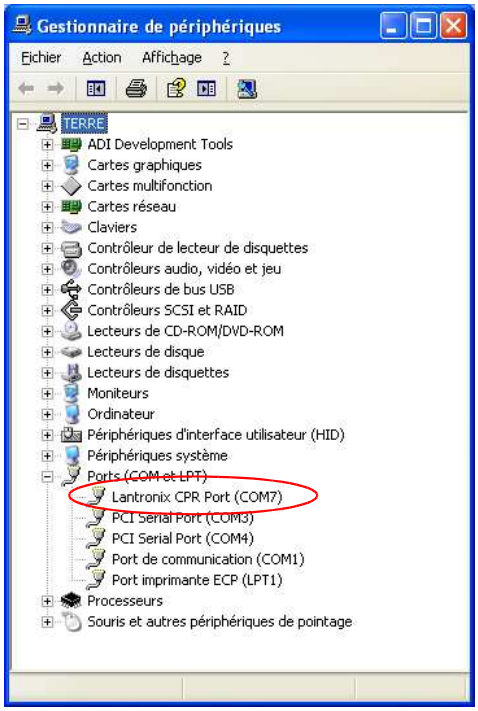
Step 13: Associate the IP address with the COM port ▪ right click on the corresponding IP address in the "device list" (e.g. 192.168.1.4) ▪ "Add to Settings"



Step 14: Save the setup, then continue


Installation matérielle
Le logiciel que vous êtes en train d'installer pour ce matériel :
Lantronix CPR Port
n'a pas été validé lors du test permettant d'obtenir le logo Windows et vérifiant sa compatibilité avec Windows XP. (Indiquez-moi pourquoi ce test est important.)
Continuer l'installation de ce logiciel peut mettre en péril ou déstabiliser le bon fonctionnement de votre système, maintenant ou dans l'avenir. Microsoft recommande fortement que vous arrêtiez cette installation maintenant et contactiez le fournisseur du matériel pour obtenir le logiciel qui a été validé lors du test permettant d'obtenir le logo Windows.
Continuer
Arrêter l'installation

Step 15 :Check the association in the device manager.



Step 16: Close the "CPR manager", the browser connection to the embedded web server and the device manager.

The reader can now be accessed via a virtual COM port (e.g. COM7) with the usual software.

11 MAINTENANCE

11.1 PERIODIC MAINTENANCE

The MRU reader requires no periodic maintenance

The MRU reader should be regularly cleaned in order to avoid dust and dirt accumulating on the case.

The MRU reader should be regularly checked for:

- cracks in the case
- missing mounting screws
- screws correctly tightened
- connectors correctly locked

11.2 REPLACEMENT

If the MRU needs to be replaced, the procedure is as follows:

- Turn off the power
- Turn the knurled ring of the plugs anti-clockwise to unlock the connectors.
- Record the reader orientation (azimuth and elevation), then remove the mounting screws and dismount the reader.
- Place the new reader in the same position, insert the mounting screws and tighten correctly.
- Replace connectors and for each one, turn the knurled ring clockwise until locked.
- Turn the power back on

CAUTION: these M12 type connectors are designed for hand-tightening only. Spanners or pliers must not be used in order to avoid damage.

11.3 RECYCLING

All decommissioned MRU readers must be returned to BALOGH SA for appropriate recycling according to directive D3E.

12 LEGAL INFORMATION

12.1 CE NOTICE

DECLARATION OF CONFORMITY

CE 0536

BALOGH Toulouse
105 Avenue du Général Eisenhower
31023 TOULOUSE cedex 1
FRANCE

This declaration certifies that the MRU reader satisfies the essential requirements of the European directive R&TTE 1999/5/EC aiming to align the laws of the Member States relating to the use of the electromagnetic spectrum, electromagnetic compatibility and electrical safety.

This declaration applies to all readers manufactured according to the technical specifications outlined in Annexe II of the directive. Evaluation of the conformity of the equipment with the essential requirements article 3 R&TTE has been done in accordance with Annex IV of the directive and the following standards:

Radio spectrum:	EN 302 208
EMC:	EN 301 489-1 and -3
Electrical safety:	EN 60 950
Exposure to electromagnetic fields:	EN 50 364

12.2 LABEL ON REAR PANEL

12.3 TECHNICAL CHARACTERISTICS AND DIMENSIONS

Radio-frequencies : ISO 18000-6 type C et EN302 208
- frequency band: 865-868MHz
- Power emitted : 2W ERP

Power supply
- voltage range: 12 - 24 Volts DC
- Current: 1.5A max

Environmental conditions
- Relative humidity: 90% non-condensing
- Storage temperature: -25°to +80°C
- Operating temperature: -20°to +50°C

Protection class
- IP65

External dimensions
- Length: 186mm
- Width: 186mm
- Thickness: 33mm/58mm
- weight: 1,8 kg

Connections available
- Wiegand 26bits, DATA/CLOCK (magnetic stripe ISO 7811-2), RS 232, RS 422, RS485, USB, ETHERNET (interfaces available depending on model)